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and Research

Research for Sustainable Development

Framework Programme of the German Federal Ministry
of Education and Research (BMBF)



RESEARCH

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Preface



The advancing climate change is one of the most important and most urgent challenges of our time. However, the UN Climate Conference in Copenhagen in December 2009 made clear how difficult it is to achieve an international agreement on binding climate protection goals.

Germany has a pioneering role in climate research and climate modelling, in the development of strategies to adapt to climate change and in climate services, not only in Europe, but also internationally. Germany is aware of its international responsibility and treats it seriously. The issue concerns nothing less than the well-being and the future of upcoming generations.

With current technologies and concepts, we will not succeed in overcoming the global challenges. We need a safe data base on the one hand and innovative solutions from industry and science on the other hand to make the impacts of climate change manageable. Research and innovation are needed more than ever to identify new development approaches and to enable technological leaps. Above all, holistic concepts are required which take into account both ecological, economical, and socially relevant issues.

The new Framework Programme “Research for Sustainable Development“, with its five fields of action, is going to meet these challenges. With this Framework Programme, we send a strong signal in economically difficult times. By 2015, we will provide funding means of more than 2 billion euros and will launch an unprecedented number of new initiatives. In doing so, we will also enable the bridging between application-oriented and basic-oriented research –

in response to the High-Tech Strategy of the Federal Government.

Investments in research and development are also investments in new technologies from Germany and in new future-proof workplaces. Therefore, we consistently count on research- and knowledge-intensive areas with pronounced growth potential, such as sustainable water management and resource and energy efficiency.

Furthermore, with the new Framework Programme we boost international research in sustainability with commitment, thus providing good preconditions for new and sustainable economic growth – nation-wide and globally. However, the main focus is on securing and improving the livelihood of future generations worldwide.

We are searching for cooperations – and therefore, collaborations with Third World countries, which are suffering most from the effects of climate change, and are of top priority. But also collaborations with so-called newly industrialized countries like China, Brazil, India, and South Africa are to be intensified. It is these countries that, in Copenhagen, did not want to or were not able to adopt the binding climate goals, that we want to become our partners in sustainability research. Research in this field has a long tradition in Germany, with excellent scientists and an outstanding research infrastructure. Based on scientific collaborations, we want to work out joint opportunities for development as well as to enable participation in prosperity and effective climate protection. No other policy area depends so much on intensive topically focused basic research, efficient systems research and the transfer of research results into industry and society as environmental policy does. The post-Copenhagen process, the international year of biodiversity 2010 and the entire Rio-process, which will be assessed in 2012, are showing and will show this clearly, now and in the years to come.

Thus, the new Framework Programme makes an important contribution to a responsible and forward-looking sustainability policy.

Prof. Dr. Annette Schavan, MP,
Federal Minister of Education and Research

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Summary

The next decade will determine whether and how we meet these global challenges. Mankind is confronted with a challenge of an unprecedented extent posed by climate change and water shortage, the threat to biodiversity, soil degradation and shortage of resources and energy. If the quality of life shall be maintained in industrialized countries and be improved in developing and newly industrialized countries, we must find ways to achieve apparently opposed goals: it is imperative to secure prosperity, to enable development and a future that is worth living as well as to reduce the consumption of natural resources and the emission of ecologically harmful substances.

The Federal Ministry of Education and Research is facing these challenges with the Framework Programme “Research for Sustainable Development”, for which funding of more than 2 billion euros is earmarked.

The Framework Programme comprises the following central fields of action:

- **Global Responsibility – International Networking**
We further expand international research collaborations, in particular with newly industrialized countries and important partner countries of the Third World. Global change requires joint global action.
- **Earth System and Geotechnologies**
We will understand climate change only when we know more about the “System Earth“. Therefore, we make considerable investments in the expansion of new research infrastructures.
- **Climate and Energy**
We conduct research for improved energy efficiency and productivity of raw materials to reduce the impact of the climate change. At the same time, new adaptation strategies are required, because in many parts of the world, climate is already changing noticeably.
- **Sustainability and Resources**
Our research is concentrated on the question of how we can protect resources and enable sustainability. We thus contribute to the provision for our future.

- **Social Development**

Sustainable concepts require changes in society and therefore also changes of each individual person. We take these social dimensions into account right from the beginning to enable the transfer of research results to everyday life.

With cross-sectional issues like “Sustainable Land Management“ and “Economic Aspects of Global Change“ this Framework Programme takes up specific questions.

Moreover, we create connections: between basic research and applied research, but also between university and extra-university research.

Goals of the Framework Programme “Research for Sustainable Development“

Research as provision for the future must generate new knowledge. This knowledge, however, must be relevant for practice. Germany is already a technology and market leader in the fields of climate protection and adaptation to climate change, sustainable resource management as well as innovative environmental and energy technologies. The Framework Programme “Research for Sustainable Development” is intended to intensify and enhance this position.

Therefore, sustainability policy also means innovation policy to us. The funding-policy activities of the Framework Programme are thus concentrated, in particular, on fields that develop future markets and further enhance the export orientation of Germany. Here, the challenges posed by climate change, scarcity of raw materials and securing of water supply are in the focus. Small and medium-sized enterprises shall be more involved in research.

The Framework Programme relies on the transdisciplinarity of funding programmes and projects. This means that all important partners of the innovation process as well as all relevant social groups need to be involved at an early stage.

Within the context of the Framework Programme, the BMBF will increasingly fulfill its moderating role. For this purpose, we will carry out agenda processes, which help us identify strategically important research issues and priority fields of research and application. The announcements of government

funding of the Framework Programme “Research for Sustainable Development” will continuously take up these topics, which turns the Framework Programme into a learning, programmatically self-renewing programme.

Last but not least, the results of these research projects will make important contributions to the implementation of legislative processes in the field of sustainability.

What is new about the Framework Programme “Research for Sustainable Development“?

Three new funding initiatives illustrate the BMBF’s new funding policy in this field:

I. Eye-level cooperations with Third World countries

Africa will be hit particularly hard by climate change. Global warming will result in poor harvests, droughts, famines, poverty, epidemics and diseases. In Germany and Europe, we will be immediately affected by the consequences – not least in the form of growing migration flows from African states.

Therefore, we will increasingly cooperate with Third World countries – at eye level – which will be particularly hit by the climate change. They shall be better enabled, at an early stage, to launch measures which contribute to the reduction of the impacts of climate change. To achieve this, we want to build up the necessary competences.

The BMBF will therefore establish the so-called “Africa Competence Centres“ (Regional Science Service Centres [RSSC]) in the next few years, which create particularly viable scientific and research structures in different regions of Africa. We will support this project with funding means of 95 million euros by 2013.

Thus, Germany is paving the way for joint responsibility in the global context. We contribute to more climate justice.

II. Research partnerships with newly industrialized countries in the field of climate protection

The UN Climate Conference in Copenhagen in December 2009 showed that specific and binding political agreements on climate change are difficult. Mankind cannot solve the climate change problem, if the major emitters of greenhouse gases – in particular from so-called newly industrialized countries – will not assume responsibility.

Nevertheless, there is a high level of willingness to cooperate in the field of sustainability research even in those countries.

The BMBF will therefore enable more research collaborations with newly industrialized countries. In doing so, we hope that these countries will make use of the jointly developed knowledge and, based on this, increasingly take measures for climate protection, such as the implementation of the two-degree goal.

For this purpose, the BMBF launches a new research initiative, which addresses in particular the “BRICS-States” (Brazil, Russia, India, China, South Africa). We provide 60 million euros for these measures alone. Here, joint research projects on environmental and climate protection technologies are the main focus. Moreover, these collaboration projects concentrate on fields with high export orientation – also for the benefit of our own economy.

III. Thorough understanding of the Earth’s Systems

Our research has enabled us to get an idea of the potential consequences of global warming. However, we are at the beginning of an overall understanding of the “System Earth”, which proves to be extremely complex. In particular, the relationships and the interplay between land, ocean, biosphere and the ice masses require a better understanding. We must drastically reduce the emission of climate-damaging gases. However, strategies to adapt to the impact of climate change are equally important.

For this purpose, we will enhance basic research by providing new infrastructures and large-scale facilities and by intermeshing them more closely with application-oriented research. Therefore, the new framework program provides, inter alia, for the continuous renewing of the German research vessel

fleet, for which 650 million euros are earmarked throughout the term of the Programme. With this, we secure the efficiency of German marine research.

We open up supranational opportunities for collaboration at the highest level and we will gain new insights in the complex ecosystem of our planet.

In addition, the Hamburg-based “Climate Service Center“, which shall provide specific application-oriented advice and services for industry, public institutions and authorities in the context of climate protection, will be supported with approx. 20 million euros from the Framework Programme Fund.

Furthermore, the BMBF provides German environmental research institutions with approx. 350 million euros per year for sustainability research. These funds complement the 2 billion euros provided for the Framework Programme up to 2015.

search results into industry and society as environmental policy does. The post-Copenhagen process, the international year of biodiversity 2010 and the entire Rio-process, which will be assessed in 2012, are showing and will show this clearly, now and in the years to come.

Thus the new Framework Programme contributes decisively to a responsible and forward-looking sustainability policy.



Prospects

These first initiatives will be followed by further ones over the next five years. The programme “Research for Sustainable Development” is a flexible and developing funding programme able to respond to current developments based on the funding policy.

There is no other policy area that depends so much on intensive topically focused basic research, efficient systems research and the transfer of re-

Preliminary Remarks



The loss of biodiversity, energy problems, scarce resources and climate change as well as the resulting social impact are challenges which are all closely interrelated both at local and at global level. We therefore need an integrated conceptual research approach which includes all important aspects at the same time- economic, ecological and social ones – in order to prevent solving one problem at the expense of another. Such an approach must be guided by the sustainability principle. Germany, as an innovative research country, assumes responsibility to meet the challenges of global sustainability.

The 2008 progress report on the national sustainability strategy shows the guidelines of the Federal Government in the field of sustainability. Emphasis is placed on the special role of research and development for achieving the national sustainability goals.

For research, the sustainability principle means commitment to a complex field of activity, where quick and simple solutions will have little chance of success. Instead, integrated networked thinking beyond disciplinary boundaries is required. The concept of sustainable development is becoming an increasingly important economic factor. The High-Tech Strategy for Germany initiated by the Federal Government meets the global challenges. Protection of climate and resources has priority. Here, decisive key issues of the future are identified which lay the foundation for a competitive knowledge society.

Key technologies – as for example materials sciences, nano- and biotechnology, environmental technologies – are important research areas for sustainable development.

This research Framework Programme implements the High-Tech Strategy in the field of

„Climate Protection/Energy“, following a systematic, integrated approach. Insights gained from research in climate and the Earth’s System is linked with social processes.

A number of observations, calculations and modellings lead to the conclusion that we will be witnesses of a climate change which, in its present form and speed, is most likely to be caused by mankind to a large extent. Thanks to intensive research on the Earth System – the interrelation between land, ocean, biosphere, atmosphere and ice masses – we are now able to get an idea of the possible impacts of global warming. There are already first indications that the sea ice sheet and mountain glaciers are melting, that the sea level rises and that the snow cover decreases. Impacts on the drinking water supply for many people are to be feared. And moreover, it is foreseeable that many species cannot adapt themselves quickly enough to these changes. Among them, there will also be those important for human nutrition.

The new key words of the international climate management are mitigation of the emission of greenhouse gases and adaptation to the consequences. Beyond the economically quantifiable costs, climate change involves far-reaching, diverse and presently hardly assessable consequences (migration, hunger, water shortage etc.), which could entail social rejections. Thus, the dual strategy including mitigation and adaptation is indispensable – with the respective consequences for research.

The supply and use of energy is an important starting point to reduce the emission of greenhouse gases. The standard of the currently available energy technology is high. Nevertheless, the mere further development and distribution of available energy technologies will not be sufficient to meet the requirements of international sustainability strategies. This already applies to the requirements of the Kyoto-Protocoll and even more to more extensive strategies. In the future, novel approaches are required that enable a leap in technology and efficiency in the conversion and use of energy on the basis of the latest technological findings.

The loss of biodiversity represents a challenge similar to climate change, to which it is closely connected. The global destruction of important habitats is proceeding, with 15,500 species vulnerable to

extinction. In Germany, the loss of biodiversity is noticeable, too: one quarter of all plants and one third of all animal species are deemed to be endangered. The extensive loss of biodiversity will not only affect nutrition, but also the functionality and resistance of the relevant ecosystems. Thus, other functions important for mankind – the so-called eco-system services – are also endangered, such as the supply of high-quality water resources, degradation of harmful substances and local climate regulation.

Sustainable land use plays a central role in the protection of natural resources and in coping with climate change. When using biological resources, it must be considered how renewables can be developed as a basis of the economy, and how the exploitation chains based on it should be designed.

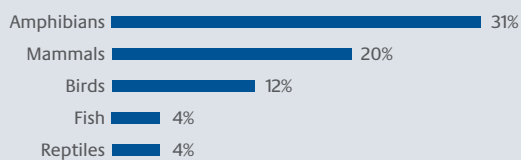


Permanent sustainable solutions are required, without exacerbating other environmental problems (soil degradation, loss of biodiversity, impairment of

water resources etc.). Apart from the related opportunities, the risks and limits are to be considered as well. All these changes of the environment are triggered by human action as well as by social development in general. The social environment, however, is by no means static. Globalization, demographic change and economic developments are factors with a decisive influence on the leeways and options for coping with these changes.

Apart from the biological resources, mineral and metal resources also play an important role in the economic activity of people. Since the beginning of the 21st century, the demand for resources has increased drastically, in particular by the immensely growing demand in newly industrialized countries. Within a few years, prices for common materials like

Endangered Vertebrates



Source: Red List 2006, World Conservation Union

copper, crude oil and waste paper doubled, tripled or even quadrupled. Thus, efficient strategies for the handling of resources – from environmentally friendly and socially acceptable extraction over the increase in efficiency up to substitution – are more necessary than ever. Innovative concepts and technologies are required on all points of the value-added chain.

Improvement of knowledge base, development of technologies, creation of options for action

Research for sustainability is an integrated, system-oriented approach, which develops innovative concepts and solutions for the challenges outlined



Solar thermic cold water generator with parabolic trough collector system and steam jet ejector chiller

above. It is intended to lay the basis for decision-making with regard to future-oriented action. For this purpose, we integrate the whole research process, from basic to application research, into the new Framework Programme. Research for sustainability

- improves our system comprehension through basic research,
- develops innovative technologies, applications and concepts on the basis of this knowledge and
- analyzes sustainable options for action for politics, economy and society.

A glance at the research programmes and policies of other countries – e.g. Japan, the USA, the EU, India or China – confirms: The holistic approach that the sustainability concept offers has already left little traces in the global research landscape.

Germany is an international pioneer and continues to claim a top position in the competition for the best ideas. With the new Research Framework Programme, we will continue to extend our lead. This is represented by four basic procedures, which are evident in the whole programme:

- Concentrating on central topics of particular urgency. These are the big topics climate, energy

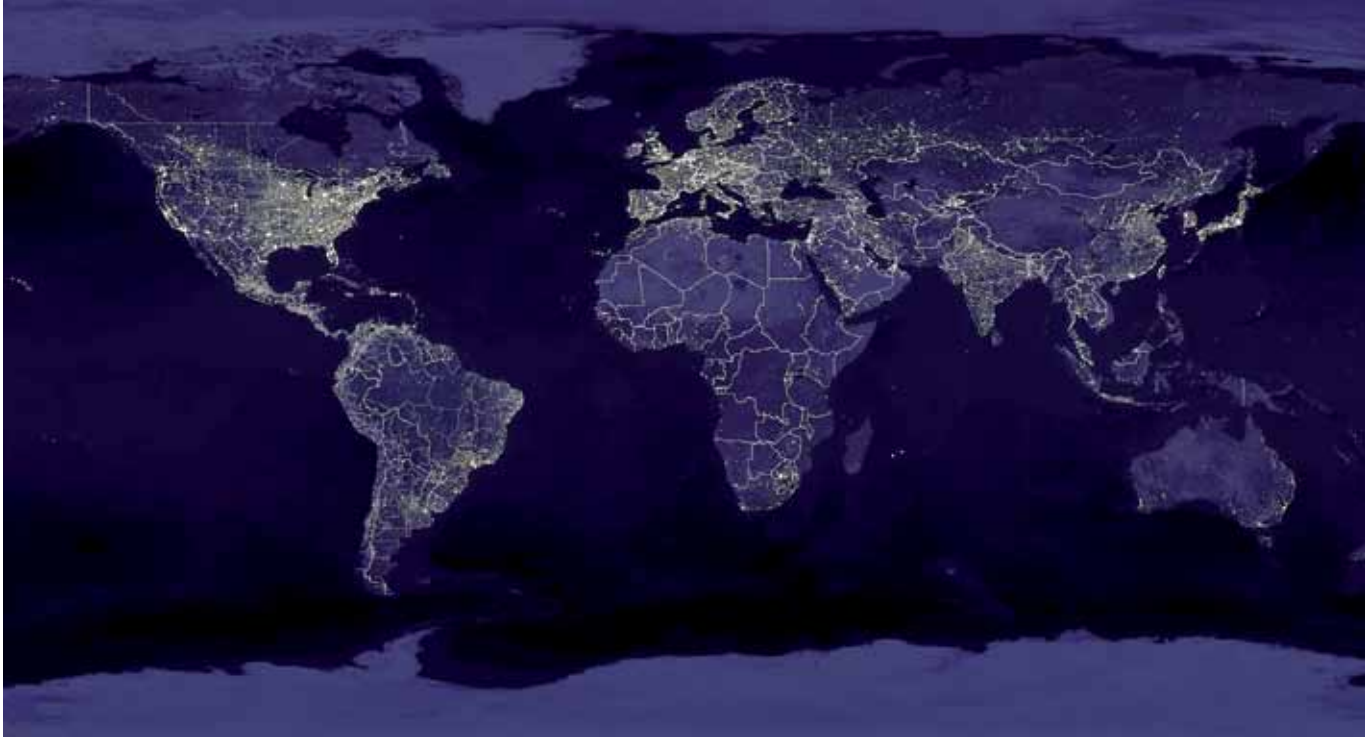


BIOTA AFRICA – Interdisciplinary long-term research for the sustainable use and the protection of biodiversity in Africa.

and resources, complemented by cross-sectional topics. The decisive factor is the systems approach.

- We link basic research to application-oriented research. For this reason, research into the Earth System and the provision of infrastructures will be integral parts of the new Framework Programme. This also includes the funding concept “Basic Research Energy 2020+“, with its basic works in energy research.
- International networking of research, to take into account of the character of the sustainability principle in a globalized world. Germany increasingly cooperates with partners from booming and newly industrialized countries. We will continue to develop our research landscape and to make it attractive for talents from all over the world.
- We expand transdisciplinary and interdisciplinary research concepts and further develop surveys on social and cultural development.

Global Responsibility – International Networking



The Federal Government has committed itself, on the European and international level, to meet the global challenges of environmental and climate protection. Due to its pioneering role in sustainability research, Germany has a particular responsibility to develop and implement technologically sophisticated and ecologically responsible prospects for the future in collaboration with the rapidly developing regions of Asia, Latin America and Africa.

In February 2008, the Federal Government adopted the strategy for the Internationalization of Science, Research and Development. Its goal is to strengthen the international collaboration with the best researchers, to jointly tap innovation potentials, to expand the collaboration with developing countries with regard to education and research as well as to assume responsibility on an international level and meet the global challenges.

This strategy shapes the structure of this Research Framework Programme. Its international fields of action are defined on two levels.

- Within Europe, the EU Research Framework Programme is the basis for the development and funding of environmental and climate research as well as of the humanities and social sciences. Therefore, this Framework Programme aspires to achieve an effective and coherent networking with the European funding initiatives and a close connection to the policy units of the EU-Commission. Its pioneering role is emphasized within the European research area; new impulses shall be given both thematically and instrumentally.

- Global competition presents the German sciences and innovation system with new tasks, which, in the field of “Research for Sustainability“, have to be mastered above all in close collaboration with the booming newly industrialized countries. The Research Framework Programme provides the partners outside of Europe with a new collaboration quality: Besides project work, the programmatic dialogue on ecological basic research, application-related environmental technologies and social sustainability concepts shall be opened up.

Furthermore, the area studies are part of the internationalization strategy of the Federal Government. The tasks of the area studies include the analysis of cultural resources, structures and development dynamics of other societies from a current and historical point of view. Area studies examine global interlinkages and exchange processes of cultural, political, economical, religious, social or legal nature. In order to maintain and improve competitiveness in the globalization process, it is essential to further develop Germany’s intercultural competence with regard to the different regions of the world. Only if a broad spectrum of expertise is available, it will be possible to communicate successfully with different regions of the world and to discuss about Research for Sustainability.

Research for Sustainability as central element of European policy making

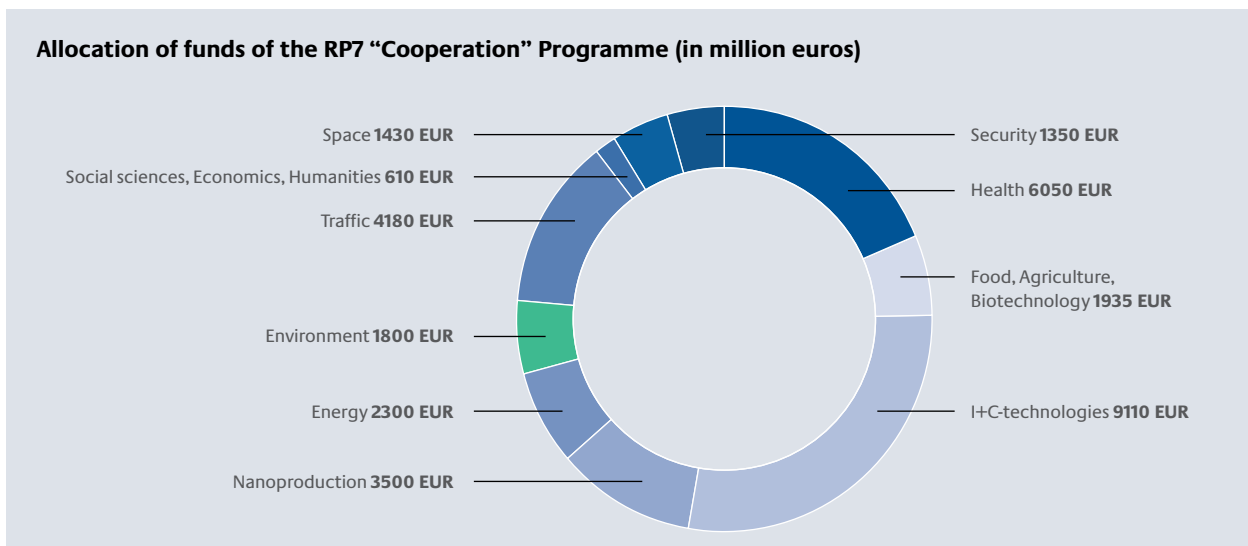
“FP7 is tailored for sustainability“: The 7th European Research Framework Programme (RP7) estimates 1.8 bn euros for project funding in the field of “Environment and Climate Change” and 610 million euros for “Social Sciences and Humanities” by 2013. For other thematic priorities, tenders for further sustainability-relevant projects are published. These activities shall be coordinated with national funding priorities and funding instruments in order to ensure optimal preconditions for researchers in the European research area. The following guidelines apply:

Learning with Europe:

Regarding the preparation of the tenders, efforts for a close coordination of national and European activities are made. This Research Framework Programme is intended to bridge the gap between national research funding to European policy making. It is, in particular, intended to promote interdisciplinarity and transdisciplinarity and is aimed at contributing to the European Sustainability Strategy. This applies to thematic focuses as well as to the conception of methods and funding instruments.

Exploiting European Opportunities:

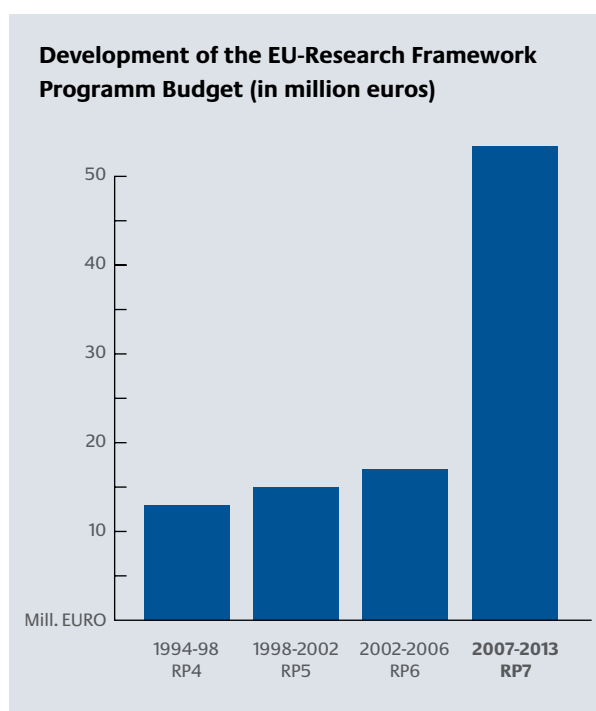
Specific European funding instruments and processes shall be used to ensure that German funding is in line with European research. We support the Commission in the definition and realization of



future focuses. Here, the further development of the Network of National Contact Points is an important component. Moreover, bilateral collaborations with strong partners will be further extended to consolidate the coordinated presence in Europe in order to extend the leeway in fields of common interest.

Shaping Europe:

Here, Germany's long years of experience in the field of sustainability should be incorporated in the Euro-



pean collaboration with third parties. Central instruments of the commission for the strengthening of the European Research Area are the ERA-Nets for the coordination of national and regional research programmes. In the first funding phase, Germany was a partner in 17 ERA-nets related to environmental and sustainability research. In the second funding phase, the BMBF, together with other German partners, develops the strategic realignment of this instrument and supports the commission in streamlining and consolidating the ERA-Net landscape.

The European Technology Platforms (ETP) are important partners when thematic focuses are

defined within the FP7. There, the most important actors of a research area (economy, science, administration and end customer) meet to create a vision for future developments and to define future research demand. The European Institute for Innovation and Technology (EIT) strengthens Europe's competitiveness: In 2009, the first "Knowledge and Innovation Communities" (KIC) on "Renewable Energy" and "Climate Change" were selected. They shall become long-term networks which bring together partners from the fields of education, research and industry to turn research results into marketable products. Germany will actively support potential German network partners in the development of the KIC.

Integrating and programmatically supporting Central and Eastern Europe

Under the German EU Council Presidency in May 2008, the research-policy representatives from Poland, Romania, Czech Republic, the EU-Commissioner for Economy and Research as well as representatives of the BMBF and of the four German research organizations signed the "Lisbon to Leipzig-Declaration" (L2L Declaration).

The aim is the development of a strategic partnership in the field of "Research for Sustainability" with Central and Eastern Europe states (MOE). Now, this needs to be programmatically implemented: In the medium term, the MOE-states, similar to Germany, want to integrate "sustainability" into their research policy. This includes, in particular, the orientation towards application as well as the transdisciplinary understanding of the research objects. The joint signing of the L2L Declaration is an example for the support the Ljubljana-Process receives up to the completion of the European Research Area.

Meeting Global Challenges

Research for sustainability is international – and the only way to provide answers to the global challenges looming in the fields of climate, resources, health, safety and migration.

The basis is a reliable network between science policy, programme planners and research funders. The aim is to develop a coherent and socially relevant overall concept out of the multitude of current and future topical fields. The Federal Government proposed such an international research agenda within

Know-how transfer to Brazil, but also to other Southern Common Market countries



In the field of disposal technology and secondary resources, new contacts to politics, research, education and industry are established mainly in Brazil, but also in other countries of the Southern Common Market, and already existing cooperations are further intensified in order to thus encourage and implement bilateral R&D-projects in the field of environmental technologies. The aspired aim is the mutual benefit: The Brazilian side benefits from the German know-how, while the German side opens up new areas of application. All this contributes both to sustainable economic growth in Brazil and the strengthened position of Germany as research and technology location in the international context.

the framework of the dialogue on the major challenges of the world economy with important newly industrialized countries, which was triggered at the G8-meeting in Heiligendamm. With the implementation of this task, the following goals are pursued:

Strengthening of the research collaboration with the world's best

German researchers shall cooperate even more closely with the world's best researchers in future. At the same time, Germany is intended to develop into the premium address for top researchers, junior researchers and talented students from all over the world in the fields of environmental technology, eco-innovation and sustainability. Particular parts of the

Programme are therefore dedicated to the funding of the new scientific generation. In addition, the access of German scientists to laboratories, large-scale facilities and joint projects in other countries is to be supported.

Being a strong partner for booming newly industrialized countries

Within the framework of the "Dialogue for Sustainability" (D4S) with booming newly industrialized countries, a number of international conferences is planned between 2008 and 2013, where topics for specific funding projects and for the enhanced cooperation of the STC (Scientific and Technological Cooperation) with other formats of bilateral cooperation, such as the development cooperation and environmental cooperation, are identified. Allowing for existing dialogue forms (e.g. the Gleneagles Dialogue on climate change, clean energy and sustainable development initiated in 2005 by the 20 states with the highest energy consumption, or the Heiligendamm-Process), ideas and proposals for the development of an international research agenda for sustainability are to be jointly developed. Thus, the visibility of private and public German actors in the rapidly growing partner countries will be improved and new research, development and innovation alliances will be established. With the D4S, the BMBF takes a pioneering role in this process on European level, which has just begun. Also, the commission and some EU-member states are increasingly aiming at bilateral research dialogues with important newly industrialized countries. In future, further significant partners will be the countries of the so-called Next Eleven (apart from Mexico and Indonesia, these include Egypt, Bangladesh, Iran, Nigeria, Pakistan, the Philippines, South Korea, Turkey, and Vietnam).

Tapping innovation potentials on international level:

German companies must secure the newly developing high-tech locations and R&D-centers of the world as partners. This strengthens Germany as an innovation location and renders it even more attractive for research investments. In future, environmental technologies and sustainable concepts will play a key role there. This Research Framework Programme implements the initiative of the Federal Government for the international marketing of Germany as research location. It presents the attractiveness of Germany and its research landscape, and intensively promotes the involvement of international research-

ers and investors in Germany. Also, the specific incorporation of international collaboration perspectives into the national funding announcements opens up new paths. The increased multilateral cooperation plays a particular role in important sustainability issues. Starting points for a better incorporation of research in an evidence-based policy, for example, are provided by the Marrakesh-Process, by the work within the framework of the UNESCO-Commission for Sustainable Developments and by the activities of the United Nations University.

Sustainable strengthening of cooperation with developing countries with regard to education, research and development:

The aim is a better coordination of the STC and the Development Cooperation (DC) to enable the developing countries in Africa, Latin America and Asia to achieve a closer scientific collaboration with Germany through modern university, research and innovation systems. The collaboration agreement between the BMBF and the Federal Ministry for Economic Cooperation and Development (BMZ) signed at the beginning of 2008 applies in particular to the topical fields of ecological and social sustainability.

Research for sustainable development of the megacities of tomorrow



The funding priority “Research for Sustainable Development of the Megacities of Tomorrow” entered the main phase of project funding in 2008. The trend towards urbanization and expansion of megacities is a global one, however it is particularly strong in newly industrialized and developing countries. By 2030, presumably two thirds of the world’s population will live in cities. This rapid development is putting to test the strategic and innovative competence of politics, economy and the civil society.

The BMBF funding priority “Megacities” is focused on the topic of “energy- and climate efficient structures in urban growth centres”. It is a globally focussed component of the German Federal Government’s “High-Tech-Strategy for Climate Protection”. It is linked to the concept of the principle of sustainable development, which responds to local need and develops solutions for the target countries. Ecological, economical and social aspects of the development of energy- and climate-efficient structures in urban growth centers are to be considered in a closed and long-term concept and researched in an interdisciplinary way.

Earth system and geotechnologies



There has been a change in the approach of the Earth sciences: Up until now, the focus was on the individual components of the system, which were researched in separate disciplines: the oceans by oceanography, the atmosphere by meteorology and climate research, the solid Earth by geology and geophysics. Now, the Earth as a system is increasingly taking center stage in research – a system, in which the solid Earth, the oceans, the ambient atmosphere and last, but not least, life are interacting complexly. Corresponding to this change, the BMBF will create a framework for an intense network of the different disciplines of Earth sciences in Germany.

Research funding shall begin precisely where the understanding of complex interactions between solid Earth, sea, icing zones, atmosphere, biosphere and changes of the Earth's orbit can be enhanced. Only this integrated approach, which profits from new insights gained from Earth system research, enables us to provide acceptable living conditions for future generations.

Focal points of research funding

Findings from research and observation of the Earth and environmental processes are fundamental for the understanding of the Earth as a system and can finally be transferred into an effective Earth system management. In order to act sustainably, it is necessary to understand and evaluate the human influence on these processes.

Systematic collaborative research shall be initiated in selected key regions, which serve as a kind of large natural laboratory. The key regions are areas likely to experience particularly dramatic changes due to climate change. They are characterized by intensive interdependence among land, sea, biosphere

and atmosphere or by intense exploitation and high population density. These include Southern Africa, the Arctic and Antarctic area, Central Asia and the German coasts. Here, the focus shall be on the interactions of geosphere-atmosphere-ocean as well as on the interactions land-sea and biosphere-atmosphere.



Continental margins

Continental margins are the transitional zone from the shelf regions to the deep sea. Man exploits and populates these regions intensively, not least because of the rich deposits of energy resources and mineral and biological resources. However, continental margins are also important in other respects, since it is there where, due to tectonic movements, geo-hazards arise, i.e. geologically caused risks and dangers. Societies in coastal regions are under extreme threat from these geo-hazards. New findings are the precondition for sustainable research in resources and successful risk research. There is need for research on the following topics:

- tectonic processes and their consequences for Earthquakes and volcanism,
- biogeochemical cycles, in particular of methane, carbon and nitrogen at the continental margins,
- complex hydrographic processes which deter-

mine transport and deposition,

- biotic communities with extremely high biodiversity and its change, such as cold-water corals,
- integrated management of coastal zones as economic and natural area.

Ocean circulation and climate dynamics

Ocean currents are a driving force for global climate. The Atlantic Ocean, for example, has a particular influence on the Western European climate, due to the North Atlantic Current. In this context, the thermohaline circulation and the related heat and mass transfer on our doorstep are of great importance. Also, the state of the marginal seas heavily exploited by humankind, such as North and Baltic Sea, is decisively influenced by the Atlantic Ocean. Thus, changes in the ocean dynamics have an immediate effect on the economy and the living conditions of human beings. The interactions of ocean and atmosphere are essential for climate dynamics. They are controlled by energy flows, non-periodic flows and substance flows between the oceans, the atmosphere, the ice and snow areas. This includes driving forces of the atmospheric circulation. Science is required to provide information, as detailed as possible, about regional changes in the atmosphere-ocean system. Research contributions are, for example, improved observation of the ocean's state, analysis of the development of extreme events, improvement of data processing and use.

Polar areas and glacier regions (Cryosphere)

The cryosphere consists basically of snow, ice and frozen soil. Today, ice covers about eleven percent of the land surface and, on a yearly average, about 6.5 percent of the oceans. Changes in the cryosphere of the northern and southern hemisphere are important early indicators for global climate change. It is only since the introduction of satellites for Earth observation about 30 years ago that changes of ice and snow can be globally observed. Despite new knowledge through numeric models, many processes in the cryosphere are only rudimentarily understood, so that further research is required in many fields: for example, on dynamics and thermodynamics of the extremely heterogeneous sea ice cover or on the dynamics of the ice sheets, in particular in regions with fast-flowing ice streams and glaciers. In addition, there are the thermodynamics of the permafrost soils and the chemical processes

occurring during melting, above all, in the regions of Siberia and North Asia.

Material cycles in the Earth system

The distribution of certain elements in the Earth system is decisively controlled by both physical and biological transport processes. The knowledge of individual biogeochemical cycles must be improved. A major concern of research over the coming years will be finding the answers to the questions of how biogeochemical cycles and eco systems react on global change and how these reactions, for their part, retroact on global change.

Here, of course, particular political and social interest is focused on the topics of carbon cycle and the increase in the greenhouse gas CO_2 . Future changes of temperature, water cycle, of currents and layer formation in the ocean and the acidification of the ocean through increased dissolution of CO_2 in sea water will have significant effects on the ecosystems ashore and in the ocean and will change the carbon cycle. It is a major concern to quantify these future changes and to understand the decisive processes; beside the carbon cycle, these include the cycles of water and nutrients.

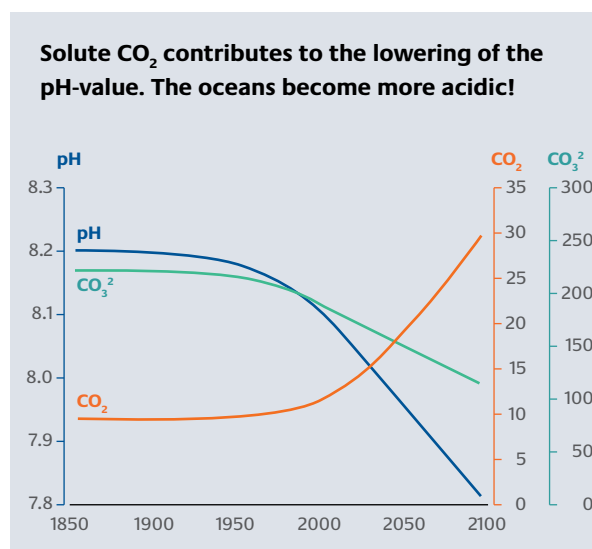
Functional biodiversity and ecosystem functions

Large-scale experiments have proved that the acidification of the oceans through increased CO_2 input impedes biological calcification. This concerns corals, in particular also cold-water corals, and plankton organisms, which form calcareous shells. Further effects on biological and chemical processes are assumed, but require further examination in detail. In many cases, the long-term consequences, which the changes of biodiversity to be observed already today will entail, are still not known or not quantifiable. For example, they may refer to changes in the fish stocks or to the poleward shift of plankton. Here, the analysis of already available data as well as experiments and modellings must establish the bases on which the depiction of probable future developments is possible.

Dynamic Earth system modelling

One of the supporting pillars of Earth-system research is modelling. Earth-system modelling helps describe the Earth and its processes to enable the evaluation of future environmental processes. It allows a holistic approach of geological processes in different model meshes in all time and spatial

scales. The aim is, for example, the identification of the feedback mechanisms in the Earth system in order to derive information on the stability of the climate system in different geological periods. The findings help predict anthropogenic influences on the climatic processes and distinguish them from



Source: Christian-Albrechts-University, Kiel

natural climate variations. A special challenge is the development of regional climate- and ecosystem models. Dynamic Earth system models, such as of sedimentary basins, are the bases for the exploration of deposits, just like the safety and risk assessment for the subsoil storage of carbon dioxide as a contribution to climate protection or for the development and exploitation of geothermal resources.

Earth system management

Large parts of the Earth system are subject to use and change by humans. Our future will depend on how rapidly efficient Earth management can be developed and globally implemented. The programme "GEOTECHNOLOGIES", as part of this Framework Programme, provides methods and technologies for the development of options for the simultaneous exploitation and protection of the habitat "Earth". It pursues the operational, application-oriented approach. It is focussed on a sustainable treatment of the Earth and goes beyond the understanding of processes. Almost all geotechnical measures on, over

The “Geotech Market“ Initiative – a model for the future transfer of technology and know-how

Currently, research results are not sufficiently converted into new products, processes and services. In particular Earth system research is often not recognized as an innovation source, although Germany is a worldwide leader in this field. The connection between research and innovation is demonstrated impressively, inter alia, in tunnel construction. The broad spectrum of possible applications however reaches far beyond the classical application fields of Earth sciences: from geo-information about aviation and astronautics, over plant engineering up to medical technology. These potentials have not been sufficiently tapped so far.

The national communication platform “Geotech Market“ yet to be founded is intended to remedy the situation: Innovations from geoscientific research shall be recognized at an early stage and successfully positioned on the market.

The priority here is to provide small and medium-sized enterprises which do not have their own research departments with facilitated access

to application-oriented know-how of universities and research institutions. “Geotech Market“ is nationally active and cooperates closely with the transfer offices of the research institutions. The initiative concentrates its activities on the first phases of a transfer process to support new technologies in the role of an incubator and to initiate and coordinate the transfer process for these technologies. Furthermore, it is intended to further and support the development of networks and the formation of strategic alliances in the geoscientific environment. It will thus become a display window for geoscientific technology development. The activities of “Geotech Market“ are based on a procedure model for efficient technology transfer. It is designed as a five-stage circulation model which – ideally – should be passed several times a year. The individual stages are: innovation screening, innovation workshops, market research, matching talks, transfer project.





and under the Earth involve large-scale deployment of personnel, machines and capital and have thus considerable effects on environment, economy and politics. Strategic management requires reliable exploration, monitoring and safety technologies which still have to be developed or need to be expanded to suit existing systems. Therefore, the previous approach pursued in the joint “GEOTECHNOLOGIES” Programme by BMBF and the German Research Foundation shall be further developed to an efficient Earth system management.

Apart from other focal points, the programme part Earth System Management will include the further development of prevention and early warning systems. Because despite all differences between extreme events – from Earthquakes to floodings – cross-sectional research areas with a basic scientific need for development can be defined. Here, the development of the Tsunami early warning system in Indonesia is considered to be a successful example of project funding.

The development, use and protection of the underground environment also gains increasing importance. Its use as storage room for the greenhouse gas carbon dioxide, as a resource for the recovery of geothermal energy or even as transport and business area is in the focus of attention.

The significance of soils as geological resources will increase globally, and the limited availability can result in competitive situations. In Earth system research, its role as a boundary layer between the lithosphere and the atmosphere in their process- and structure-based functionality has been insufficiently recognized. Thus, basic research on processes, structures and functions in soils shall be enhanced for a better understanding of the processes close to the surface.

Funding instruments

The comprehension of the complex system “Earth“ requires intensive cooperation and networking of different disciplines in Earth-system research. Project funding will be oriented on this aspect.

Large-scale facilities are turning more and more into connecting research platforms for disciplines, institutions and nations. Investments for platforms like vessels, stations, observatories and airplanes are included in the research budgets of the respective institution or made available by federal and state governments and the German Research Foundation (DFG), respectively.

Therefore, the planning of the deployment of research vessels across disciplines and organizations shall be enhanced. In future, there shall be uniform evaluation processes for proposed trips of all medium-sized and large research vessels. International cooperations for the use of research infrastructure are another step towards increase in efficiency.

The BMBF will enhance its funding activity for structure-building measures at programmatic and individual interdisciplinary interfaces. This funding will be limited in time (usually three years). Here,

tasks are concerned, which are either completed within this period or which are afterwards included in the budget of a scientific organization. In this case, the BMBF-funding represents start-up financing.

Virtual teams/institutes, clusters or strategic alliances shall be funded to work on new current topics on an interdisciplinary basis. Examples for this could be competence networks for risk management or Earth system modellings, which establish new structures, pool results obtained across disciplines and provide services for scientific groups. A joint project for the development of a data-management structure for Earth system research would also correspond to the new funding approach. Funding is used for coordination tasks, for research work and necessary investments.

Beside these new funding approaches, further scientific interdisciplinary collaborative projects are funded both on a problem-oriented and system-oriented basis. Collaborative research work shall be more focused on “hot spots”, such as natural regions or model regions, and on priority topics. Above all, potentials of new basic technologies, as for example of carbon-capture and storage technologies, modern early-warning systems or new geo-information systems shall be tapped. Depending on the possibilities, partners from industry, mainly SME, are to be integrated. At least one junior group per funding topic should be funded to enable the establishment of long-term competence on these issues in Germany. Apart from staff appropriations for three or four persons, this instrument provides also consumption and investment funds and is limited to three years. The international collaboration is intended to be further developed according to specific topics and following the internationalization strategy.

Institutional funding

The BMBF finances major scientific organizations on a proportional basis, such as the Max Planck Society, the Helmholtz Association and the Leibniz Association. The contributions to Earth-system research are provided by the institutions of the Helmholtz Association within the framework of their “Earth and Environment” Programme (geosystem in transformation, atmosphere and climate, ocean, coastal and polar systems, biogeosystems: dynamics and adaptation, sustainable development and technol-

ogy), the institutes of the Max Planck Society within the framework of their “Earth Sciences and Climate Research” and the Leibniz Association in Life and Natural Sciences. The DFG is involved through priority programmes and is partner of the BMBF in the programme “GEOTECHNOLOGIES”.

First steps towards implementation

1. Key region: German coasts

The BMBF is already involved in the consultative process with scientific associations and practice-oriented users of oceanographic research on North and Baltic Sea aiming at the conception of a research agenda for the German coast. As of autumn 2010, the BMBF accompanies the implementation with targeted funding measures of the new Framework Programme.

2. Key region: Central Asia

The BMBF, in collaboration with science, is preparing a support project for research into the monsoon system in Central Asia. Central Asia is understood as the area of the Pamir-Tibet plateau and the adjacent mountain ranges and sedimentary basins. This area is highly characterized by the combination of geodynamic, climatic and anthropogenic influences.

3. Key region: Southern Africa

Southern Africa is a key region in the forecasts of climate change. The land-ocean interaction in close connection to the biosphere shall be in the focus of a systemic research cooperation, the scientific core issues of which are currently being compiled.

4. Key region: The Arctic

The BMBF enhances its funding measures for the expansion and common European use of the Arctic research infrastructures during the programme period. The ice-breaking research drilling vessel AURORA BOREALIS, the European Multidisciplinary Seafloor Observatory (EMSO) and the Svalbard Integrated Arctic Earth Observation System (SIOS) have been included in the prioritized list of the European Strategy Forum on Research Infra-

structures (ESFRI) and will receive funding of the EU-Commission supported by the member states during the preparation phase.

5. GEOTECHNOLOGIES

- Start of the collaborative projects of the current funding announcement “Tomography of the Usable Substratum – From Sound Transmission to Real-Time Monitoring“ within the framework of GEOTECHNOLOGIES in 2010. Funding of approx. 9 million euros is earmarked for this project.
- Publication of the funding announcement “Management of Global Biogeochemical Cycles“ within the framework of GEOTECHNOLOGIES at the beginning of 2010. Funding of approx. 9 million euros is earmarked for this project.
- Based on the results of the joint GEOTECHNOLOGIES Programme of BMBF and DFG, the given focal points of GEOTECHNOLOGIES will be further developed. The Earth sciences in the sense of Earth system research play a major role in safeguarding the future of humanity and Earth.

Climate and Energy



Climate change presents mankind with a global challenge we can only meet together, since it affects almost all areas of life and regions of the Earth. An unhindered climate change would have considerable impact on the way of life of mankind and would massively affect the basis of life in many countries.

Investments in climate protection are worth the effort in two respects. They contribute to the careful use of our resources and to the preservation of our habitat for future generations. At the same time, investments in climate protection open up new chances for our economy. Technologies, products and services developed in Germany for climate protection and adaptation to the climate change already play a leading international role in many fields and are accordingly in demand. Investments in such technologies secure long-term employment and economic growth in Germany.

The BMBF contributes decisively to the “Integrated Energy and Climate Programme (IEKP)” of the Federal Government. The planned measures pursue the objective of joining forces and accelerating innovation to achieve the goals of energy and climate policy more easily and efficiently. They complement the IEKP, above all, by giving a perspective for the innovation policy beyond 2020 and combine technological approaches with the expansion of an integrated research landscape on climate change and energy research.

Intergovernmental Panel on Climate Change (IPCC)



The IPCC-Delegation with the gold medal and the Nobel Peace Prize Certificate in front of the Oslo Town Hall

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR4) conveyed three decisive messages: First, human activities are responsible for climate change. Secondly, mankind will risk dangerous climate changes if the increase in emissions continues as before. Thirdly, the stabilization of CO₂ on an acceptable level is affordable and technically feasible. It is recognized that a package of measures for the adaptation to climate change and precautions for its mitigation must be initiated at short notice, since otherwise the consequences might be too harsh to be combated. In view of the interaction of climate change and sustainable development, such measures could contribute to a development, which will indeed be sustainable.

The IPCC AR4 proves that the governments must initiate a number of comprehensive strategies and measures, among others, intensified efforts in the field of research, development and presentation, with emphasis on a stronger orientation of the new research activities towards the closing of knowledge gaps. First priority is the integrated analysis, research and evaluation of mitigation and adaptation measures for the elaboration of solutions. Meanwhile, the IPCC began working on the Fifth Assessment Report (AR5), which is scheduled to be completed by 2013/14. AR5 is shifting the emphasis from the understanding of the climate system to the identification of

the consequences, the evaluation of adaptability, and moreover, to the cost assessment and to the evaluation of strategies for the mitigation of dangerous climate changes. The IPCC realizes the necessity, on national and international level, to considerably increase the number and the spectrum of the actors involved. With the election of Professor Ottmar Edenhofer (PIK/Technical University of Berlin) as co-chairman of the IPCC Working Group III on Mitigation (WG III) and the funding of the WG III Technical Support Unit by the BMBF, Germany will play a leading role in the activities of the IPCC within the framework of the Fifth Progress Cycle (2008-2014), which will make German research on climate change internationally more visible.

The more intensive feedback from the ongoing IPCC-process, which is to be expected, will contribute to new research priorities and to the intensification of the German research on climate protection. Within the next seven years, the IPCC WG III will establish solution strategies for climate and energy issues and lay the foundations for global emission trading. Basic research can provide methods of resolution in many fields of climate economy. In order to provide decision-relevant knowledge for actors in economy, civil society and politics, the main emphasis should be on key topics like risk management and issues of public welfare, equality and justice as well as on the development of long-term policy making.

A core concern of the future public and scientific discussion will be the clarification of the requirements for the mitigation of the climate impact and the limits of adaptability to climate change as well as the identification of solutions.

Focal points of research funding

In the field of action "Climate and Energy", funding is focussed on the following areas:

Processes and interactions of the climate system

Climate system research, with its model simulations and scenarios, lays the foundation for all climate protection measures and for the adaptation to climate change. Consequently, it is of particular importance. It requires:

- the further development of these models and scenarios with the goal to limit the spectrum of the expected developments and to assess the probability of extreme states,
- improved temporal and spatial resolution of the scenarios to enable reliable conclusions for decisions about adaptation issues on the decision levels of government, federal states and regions,
- progress in the understanding of processes and interactions, which determine the Earth's climate (e.g. in oceans, ice and snow, at the boundaries of the terrestrial and marine biosphere as well as in the upper Earth's atmosphere),
- the measuring, analysis and forecast of the carbon and hydrological cycle as well as of the trends of all gaseous and particulate, climate-relevant trace substances, and
- data from satellite-based and other observation methods for the monitoring of climate change.

Landscape and soil are more and more in the limelight of scientific interest, in particular because of their importance as sources or sinks of climate-relevant gases. Little is known so far about the actual role of natural landscape and the different forms of land use for climate change. It can be assumed that climate change does not only change the landscape itself, but also the demands on land use. These issues are closely intertwined and can only be investigated by means of integrative research approaches.

Adaptation to the inevitable consequences of climate change

Independently of the efforts to protect the climate, suitable adaptation strategies for possibly occurring changes must be developed. Focal points arise

also in developing and newly industrialized countries, which are particularly affected by presumably stronger impacts of climate change and due to their lower economic and social resistance. Adaptation means basically the management of climate impacts on man and environment, on prosperity and quality of life, on economic and social development. This management implies a better understanding and the assessment of the risks, just like the understanding of social and economic potentials and conditions for adaptation. This means,

- to identify regional and sectoral-based impacts of climate change,
- to recognize knowledge deficits and
- to develop strategies and technical solutions for adaptation measures.

Whether competitiveness, prosperity and quality of life can be maintained as usual also depends on the ability to anticipate future climate conditions and to initiate adaptations. Applied research on adaptation to the consequences of climate change must therefore go hand in hand with improved forecast of extreme weather events and their impact on ecological systems or economic sectors. The quality of forecasts depends on the improvement of the short-term forecasts. The results of this research area allow the development of effective alarm systems and the taking of precautions and political control measures for crisis situations.

"Basic Energy Research 2020+"

The BMBF supporting concept for energy research "Basic Energy Research 2020+" (published in 2008) is an integral part of the 5th Energy Research Programme of the Federal Government, spearheaded by the BMWi. The activities described serve climate protection, since they are targeted at the reduction of CO₂-emissions in energy generation and utilization. Thus, energy research is in the front rank of the new research programme.

The funding concept is focused on fields of energy research, in which new technological options are developed that still require basic research before they are ready for application. With this, research work on efficient energy generation and conversion, including energy storage, energy transport and end use of energy, as well as on the reduction of green-

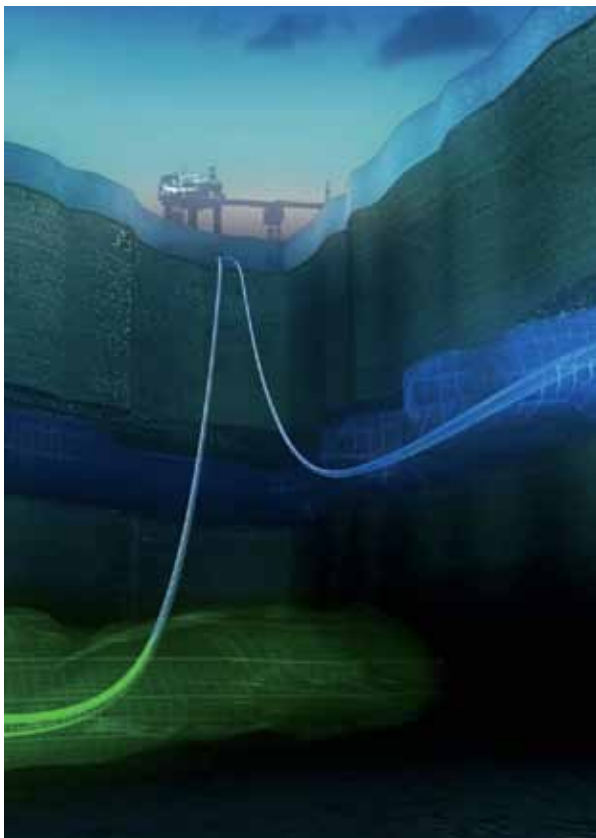
house gases shall be supported.

In view of these strategic goals and with regard to the reduction of harmful gases, the following issues are funded:

- solar energy plants and methods of the next generation, in particular thin-film photovoltaics and biomimetic hydrogen production,
- bioenergy production and conversion,
- sustainable CO₂ storage and use.

R&D-work on energy efficiency is intended to be carried out in the final consumption sectors Buildings, Industry and Services. This also includes system analysis.

The integration of research activities in the area of key technologies shall give a boost to innovation



Injection of captured CO₂ into saltwater-bearing sand layers (green: stratum conveying natural gas, blue: CO₂ injection stratum)

in energy efficiency. Therefore, the energy-relevant research activities in key technologies funded within the framework of other BMBF programmes will be included. In order to gain and further expand technological options, targeted research work in the fields of fusion research (in particular measures to support ITER) and nuclear safety as well as repository research is funded. This serves the particular purpose of preserving and expanding nuclear competence on the highest levels of science and technology.

Further funding topics are conceivable in the implementation of the Research Framework Programme, for example, in connection with the Federal Government's national innovation programme for hydrogen and fuel cell technology or for energy and heat production with low CO₂ emission.

Political and socio-economic controlling factors for climate protection and climate adaptation

The weighing of different strategies to achieve the climate protection and adaptation goals in global, economic and sectoral terms and the assessment and modelling of the impacts (costs, risks, structural change) of political reduction goals require increasingly precise and comprehensive methods. The economic effects of climate change and the contribution of economic sciences to the development of political and market-economy oriented instruments for the reduction of greenhouse gas emissions turn into a challenge for research funding. Important issues refer to the reduction goals and their impacts, their assessment and their modelling.

Which political, economic and social instruments are required to achieve these goals? What impact will climate change have on the world's economy as a whole, on individual economies or on specific industries? In addition, the central areas of need of private consumption must be considered, such as mobility, housing, nutrition and leisure.

Specific research and development measures are required to enable the financial sector to contribute to the implementation of the sophisticated goals of climate protection and adaptation. Without capital, loans, insurances and investments, innovation cannot be converted into products and services.

Another focal point of research into climate change must be further-reaching social control elements for the reduction of greenhouse gases. Basic



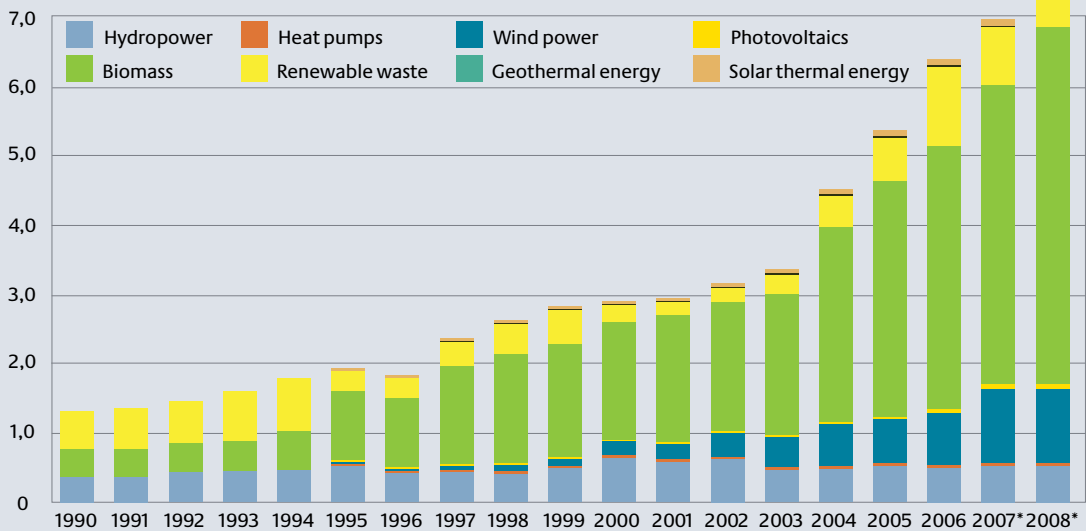
know-how for this arises from research projects, in which leeways of politics, citizens and consumers are sounded out and social, economic and (regulative) political innovations are developed and tested. This also involves processes for the assessment and the

handling of unintended impacts of climate protection measures, for example, in connection with new technologies.

Harnessing know-how for decisions

In the future, possible changes due to climate change need to be considered in many strategic decisions. Companies, for example, must clarify how climate change influences the conditional framework of their investment decisions or the development of their markets. Politics, too, need reliable forecasts and a useful classification of these data to shape social change characterized by global warming. Thus, improvement of the possibilities for information and consultancy is a key task to enable the interpretation of expert knowledge and its use as a meaningful basis for decisions in most different fields. This requires the bridging of the gap between climate system research and the users of the climate data in a carefully considered way.

Decentralized knowledge and corresponding advice regarding its interpretation must be made available as a service from one source, data must be processed purposefully and be put into a reasonable context, and specifically required data must be generated. This is the only way to conveniently integrate



Contribution of renewable energy sources to primary energy consumption 1990 - 2008, in%. * Provisional, partly estimated. Source: Calculation of EEFA after AGEB

Tsunami early warning system



On November 11, 2008, the German Indonesian Tsunami Early Warning System was put into operation. With this, Germany has contributed decisively to disaster control in Indonesia.

In future, people in Indonesia can protect themselves better against natural disasters: The Tsunami Early Warning System, in the develop-

ment of which German scientists were significantly involved, is entering a two-year optimization phase. Less than four years after the catastrophe of December 26, 2004, where 230 000 people lost their lives, an effective technology for the protection of people was ready for use.

In the new warning center operated by the Meteorological, Climatological and Geophysical Agency (BMKG) in Jakarta, researchers have combined new scientific methods and technologies to develop an early warning system that is one-of-a-kind worldwide. Technology enables the authorities to quickly and reliably warn against an approaching Tsunami. The Decision Support System (DSS) developed in Germany is the core of the new warning centre. Highly automated, it supports the decision making of whether (and if so: where) alarm should be triggered.

All information available converges in the DSS. Then, the data is compared with already calculated Tsunami simulations, which are possible on Indonesia`s shores. Operating staff is trained to ensure sustainable operation.

Together with Indonesia, financial models are developed which guarantee operation and maintenance from 2010.

information into strategic planning and investment decisions.

Funding instruments

The research areas described are mainly supported through project funding. Moreover, new forms of collaboration and funding instruments can also be used to reach the research policy goals of the Federal Government.

Key components, in this connection, are specific agreements between decisive actors from the economy, science, and research politics for the implementation of joint research, development and presentation projects, for example in the form of innovation alliances. In addition, coordinated applications of all

German research institutions involved would make sense in some of the mentioned funding fields of climate research.

Another element is the establishment of the "Climate Service Center", which is intended to provide better availability of knowledge regarding climate change. The CSC is a new information and advisory platform for decision makers and investors. There, climate data are prepared on a scientifically solid and demand-oriented basis to enable the results of climate research to be included, more specifically than before, in decision-making processes of politics and economy. The CSC is organized as a network with a central core area, in which the available climate expertise and climate-related advising are included.

Institutional funding

Germany's potential for integrated climate research is high: Already today, Germany has an excellent research landscape, which, with a number of universities and extra-university research institutions, belongs to the best around the globe. Thus, institutional funding accounts for a large part of climate research funded by the BMBF. It covers various institutes of the Max Planck Society, the Helmholtz Association and the Leibniz Association.

The institutionally funded research facilities shall be further supported to enable an even stronger concentration of their resources, in order to orient research towards joint goals and to take a leading role on an international level. According to their

tasks, the Helmholtz Centres work on topics of high complexity, with long development times and high performance risks; they dispose of the required technical pilot plants, infrastructures and human resources.

The focal point of energy research funded by the BMBF is the institutionally funded energy research and technology development in the research centres of the Helmholtz Association. Here, the focus is on the following fields:

- Thin-film photovoltaics,
- Solar and geothermal energy,
- Biomass processing,

Innovation Alliance LIB 2015

At the end of 2007, the Federal Ministry of Education and Research (BMBF) established the Innovation Alliance "Lithium-Ion-Batteries" (LIB 2015). With this alliance, the BMBF supports joint research in companies, universities and extra-university research institutions, which are targeted to the development of a new generation of big and safe lithium-ion batteries.

Big, powerful lithium-based energy stores are required to enable the more efficient everyday use of e.g. hybrid or electric cars or of regenerative energy sources. Therefore, the BMBF supports the coordinated development of a new generation of powerful lithium-ion batteries along the entire value-added chain in Germany. In doing so, suitable materials and methods for the manufacturing of individual battery-cell elements are developed, new concepts for the production of total battery systems are established and new intelligent battery management systems are tested. The funded projects shall result in specific prototypes. Based on a public announcement, the BMBF is going to invest 60 million euros over the next four years, in addition to the extraordinary commitment of industry. The LIB 2015 initiators alone, the companies BASF, BOSCH, Evonik Industries, Li-Tec and Volkswagen, have promised investments of

more than 360 million euros in this research area. Moreover, LIB 2015 relies on a closer collaboration and coordination with basic research (German Research Foundation) and the institutionally supported research (e.g. Helmholtz Association).

With the German Climate Computing Center (DKRZ), German climate research institutions in collaboration with international groups operate a high-performance computing center for basic research and applied research in climatology and immediately related disciplines.



- Power plant technology,
- Fuel cell technology,
- Fusion research,
- Nuclear safety and final storage

Within the framework of the new funding concept, project funding and institutional funding shall complement one another and shall be closely intertwined.

First steps towards implementation

The implementation of funding goals occurs mainly through funding announcements on the focal points. In some fields, specific funding announcements are in the planning stage or funding priorities

A funding announcement is scheduled for the end of 2010. With the planned funding of the focal point “Medium-Term Climate Prediction”, a model system for the prediction of expected changes in climate and its extreme weather conditions on a time scale of up to 10 years shall be developed, taking account of both anthropogenically induced climate change and natural climate variations. Funding begins in 2010.

In addition, close collaboration with European partners is aspired in this field, also within the framework of the so-called Joint Programming.



are in progress and further announcements will follow. With the new funding priority “Economics of Climate Change“, economic and social research into climate change is further expanded. Moreover, the decision-making bases for politics, industry and finance will be improved. A first announcement is scheduled for the beginning of 2010. With the new funding priority “Adaptation Research in Economy“, the decision-making basis for enterprises when dealing with climate change shall be improved.

Sustainable management and resources



Natural resources are the basis of the economic activity. Important natural resources include biomass, ores or fossil energy sources. In addition, there are environmental media (waters, land, atmosphere, sun), flowing media and the physical space of land and soil as well as biodiversity which jointly characterize the resource “nature”. The worldwide growing demand for raw materials increases the pressure on ecosystems and environmental media. At the same time, human utilization has immediate consequences for the natural environment.

Even though many mineral raw materials will be available on our planet for quite some time, the aim should be to achieve closed raw material cycles through the improvement of efficiency in the use of raw materials, increased recycling and the enhanced substitution of fossil fuels by renewable or secondary raw materials.

Adequate ecological and social standards are to be observed during the extraction and treatment of raw materials. For a sustainable economy, all resources must be treated with care and used more efficiently with the help of innovative technologies and services, and resource productivity must be boosted by optimized value-added chains. This requires systematic research into cross-industry material flows from the angle of sustainability. Innovative environmental technologies contribute decisively to resource protection, in particular to the protection of environmental media. They play an important international role in the limiting of negative impacts of globalization on the environment.

Project: “Roadmap Environmental Technologies 2020“



Bionic principles may contribute to the increase in resource efficiency.

The BMBF wants to know where the most important topics of future relevance in environmental research are to be expected, in order to set the right course for the future in good time by means of funding programmes. Therefore, a survey conducted on behalf of the BMBF determines the contributions that research and technology can make for future innovations in seven environmental sectors. The fields of biodiversity, water protection, climate protection, waste management, soil conservation, resources and air pollution control are examined. Environmental technologies in the mentioned sectors are generally viewed as system solutions under consideration of the framework conditions. The goal of the project is to identify strategic options for action for research funding and for the promotion of the transfer of knowledge into practice. The project is thus of cross-sectional nature, in order to identify those fields among the various environmental technologies that, due to their dynamic development, provide particular opportunities.

Future lead markets for environmental technologies shall be determined at an early stage and

innovation activities in such fields shall be targetedly supported.

In the field of action “Conservations of Finite Resources“, different strategic approaches are surveyed to achieve this goal. The approaches for increased raw material productivity are implemented in different phases of the product life cycle, with product design and manufacturing processes providing the greatest potential for environmental innovations. As a result, the broad range of technologies available for boosting resource productivity is shown in a Technology Compass to facilitate orientation towards the future.

The results of the project provide options for future development paths, which shall be explored within the context of this Research Framework Programme. Thus, within the framework of the Federal Government’s High-Tech Strategy environmental technologies are intended to make an important contribution to coping with growing global environmental problems. This field provides lucrative markets for German enterprises. Therefore environmental technologies are an integral part of research funding in the field of action “Sustainable Management and Resources”.



Biodiversity is one of the seven examined fields of innovation. The relation between plant diversity and ecosystem functioning is examined on these experimental fields.

Focal points of research funding

Research is guided by the aim to provide system solutions for sustainable management. For the further development in terms of research policy, the following aspects are focused on:

- In a globalized economy, raw material flows and value-added chains are already internationally intertwined. And, in part, the ecological, economic and social consequences of economic activities have global effects, too. Initial approaches to sustainable management must take these global dimensions into account.
- Central elements of system solutions for sustainable management are technological innovations, which aim at an ecological and economic development with long-term sustainability. This includes, in particular, environmental and climate protection technologies, which help open up important international lead markets. Water technologies are an example of how export can be boosted, while, at the same time, international responsibility is assumed.
- Technological innovations shall be linked with non-technological ones (for example services, organizational innovations, actors' cooperations) in order to achieve the required broad effect. Innovative service concepts play an essential role in the increase of added value with a simultaneous reduction of the use of resources.
- In order to achieve the best possible effects, innovation research methods are applied (such as technology foresight, innovation and technology analysis). The aim is to use innovation time slots for technology and market developments in an optimal way, to improve the accuracy of funding, but also to enable basic concept innovations beyond existing technology developments. Moreover, cross-industry conflicts of use for scarce strategic resources shall be anticipatorily considered (for example indium scarcity caused by LCD-screen production).
- Funded projects must also take explicit account of adjacent systems and orient themselves towards the sustainability goal (for example socio-economic consequences, life-cycle considerations, analysis of potential environmental effects and

problem shifting). Therefore, methods of sociological and, increasingly, of economic research are to be applied in interdisciplinary and transdisciplinary projects.

Research funding in the field of action "Sustainable Management and Resources" is focused on four topics:

Nature as a resource

Research for the sustainable use of land and soils as resources is closely intertwined with the cross-sectional topic of land management and some aspects of climate change.

Urgent issues in the field of biodiversity concern the sustainable use of ecosystem services, interactions with environmental policy goals, such as climate protection and other resources like water, and the relationship between global change and biodiversity. Due to the strong interaction with different options of land use, these issues are integrated and considered in the cross-sectional issue of land management.

Nature with its proven and optimized solutions is a role model for technological developments. This is the principle of success of bionics. The BMBF pursues the goal of transferring sustainable bionic innovations into economic applications and of further supporting the development of this research area, which is still in its infancy.

Sustainable water resources management:

One of the major challenges of the future is to ensure the supply of clean water to the world population. Population growth, water pollution and the increasing water consumption per capita have a strong impact on water quality. In addition, expansive climate changes and change in land use influence global and regional water cycles and thus question the medium and long-term availability of water.

We can only meet the upcoming ecological, economic and social challenges of the 21st century, if this outstanding importance is taken into account by means of integrated research approaches. Water as a resource needs to be used and conserved sustainably in terms of an integrated water resources management.

This approach requires a high degree of understanding of the system across different scales and respective governance processes – even on international level. Cross-references to the cross-sectional issue of land management, for example, arise in the field of agricultural economy. At first, technological innovations and system innovations developed in Germany need to be successfully tested in the domestic market, to enable local suppliers to demonstrate system competence and to convince the world market. The basis for this must be established within the framework of national research activities. Current challenges which have to be met on both the national and international level, are the adaptation to the impact of climate change, responses to changing political framework conditions as well as the adaptation to the consequences of the demographic change.

Efficient and sustainable value-added chains

Concepts that increase the productivity of resources contribute to the reduction of resource and energy consumption, and thus provide high benefits for economy, environment and society. Scarce resources

will be protected, a contribution is made to combating climate change and, due to the reduction of the material costs, the economic clout of businesses will simultaneously be enhanced. Here, research concepts must consider technological and social interactions. Thus, value-added chains, product life cycles and possible feedbacks in intertwined value-added chains are increasingly in the focus.

Efficient and sustainable value-added chains encompass the sustainable supply of resources, substitution strategies for scarce and strategic resources, innovative manufacturing concepts within the framework of production and the introduction of new material cycle concepts and recycling technologies. The combination of innovative services with efficient technologies provides particular potential. The connecting elements within the value-added chains, for example logistics and value-added management, can contribute to considerable increases in economic efficiency. High potentials are seen in new concepts of ecodesign (bionic development concepts, lightweight-construction products) as well as in new product management concepts (expansion



In the MoMo-Project, leading experts from Germany and Mongolia examine the catchment area of the Kharaa River as a model region of Central Asia to develop adapted and transferrable strategies and technologies within an Integrated Water Resources Management (IWRM)

of product life, operator models, chemical leasing). Innovative environmental technologies help reduce environmental pollution related to the use of raw materials.

Moreover, cross-sectional technologies, such as biotechnology, material sciences, bionics or nano-



technology play an important role. The funding provided by the respective specialist programmes of the BMBF is complemented in this programme by projects with exemplary orientation towards the sustainability goals.

The funding is intended to bundle research and technology development, to mobilize the innovation potential of small and medium-sized German enterprises and to boost the implementation of research results in industry. High priority is assigned to “innovation leaps” with cross-sectoral effects, which go significantly beyond the state of existing technology or organizational structures.

Biogenic raw materials

Biogenic raw materials, i.e. raw materials of plant, animal or microbial origin, are an increasingly important alternative to mineral and fossil raw materials and make an important contribution to the protection of the latter. Apart from energy generation, their use is particularly promising in application fields with high value creation, as in the so-called green chemistry as lightweight construction material, packagings and building materials.

Furthermore, there are unexploited potentials for the mobilization of biogenic raw materials, which are to be tapped. On the other hand, there are land-use competitions (for example energetic use against material use of wood) or area competition (for example between the cultivation of renewable agricultural raw materials and food plants).

Moreover, the use of biogenic raw materials has effects on other resources, such as soil, water or biodiversity. Such conflicts need to be viewed systematically to achieve sustainable development. Biogenic raw materials should be sustainably produced and processed with high added value in order to optimize raw material flows. Intelligent solutions – for example coupled or cascade utilization – will provide particular opportunities.

Against this backdrop, untapped potentials for the sustainable production of biogenic raw materials shall be mobilized by the system-oriented research funding. Also surveyed are the optimization of logistics concepts and value-added chains for the efficient use of these raw materials as well as contributions to



Decentralized water and wastewater technology will become a preferred alternative to centralized water supply and wastewater disposal for many arid areas of the world and those that are difficult to access. In this project, the BMBF supports the development of a system for the recycling of grey water and black water for major building complexes.

SME-innovative: Small and medium-sized enterprises as innovation drivers for the improvement of resource efficiency

Small and medium-sized enterprises (SME) are often those that boost and use particularly efficient technologies. Consequently, they are in the vanguard of technological progress in many fields. Own innovations or the early implementation of particularly innovative methods improve resource efficiency.

The funding initiative “SME innovative” wants to support the development of innovative technologies for resource and energy efficiency. In the focal point “Resource Efficiency”, SME work out specific contributions for the sustainable use of resources – individually or jointly with other companies or research institutions. This includes, e.g. the development of new processes for the closing of material cycles in metallurgy and electroplating. Precious metals from residues previously unused are exploited by means of new technologies and are returned into the production cycle. In the field of recycling, laser technology for the automatic sorting of mixed scrap metals is further developed to obtain single-component fractions.

Other SME are active in the development of resource-saving vibration cleaning methods or intelligent logistics solutions for the measuring of wood by means of mobile-phone photographs on the way from the forest to factory. In the field of resources and energy efficiency, the “SME-innovative” has no thematic restrictions. It aims at all innovative SME from a variety of industries. With “SME-innovative”, the BMBF enables easy access to research funding for small and medium-sized enterprises in important fields of future relevance, since risks related to cutting-edge research are often difficult to calculate. For this purpose, the BMBF has expanded the consultancy service for SME and has simplified and accelerated the application and approval process.

www.kmu-innovativ.de

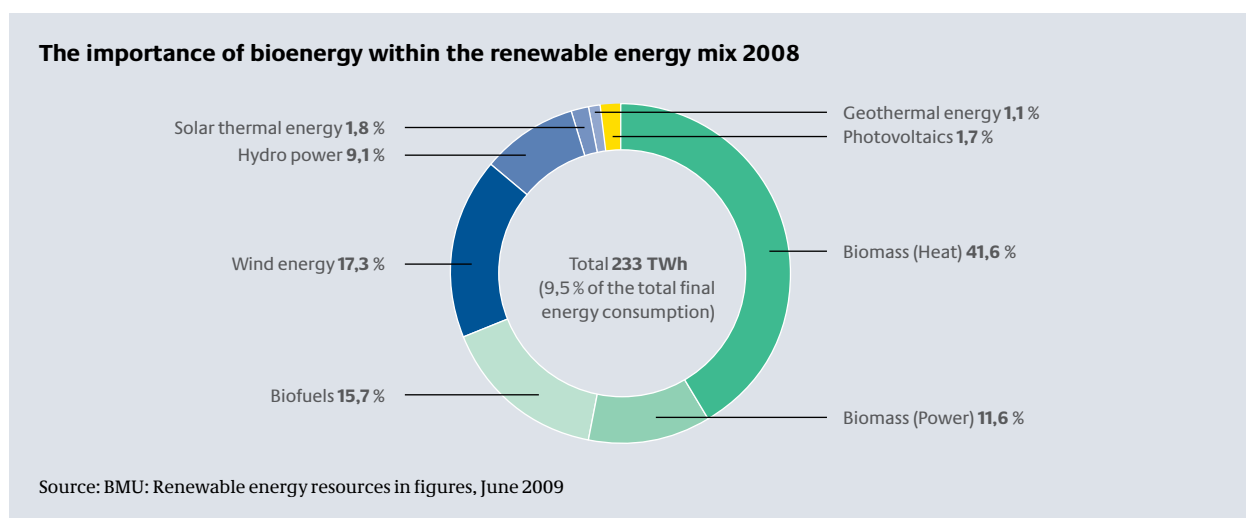


the development of innovative products, technologies and services for the development of the existing substitution potentials.

The decisive technological tasks for the optimization of the plant as a raw material basis as well as biotechnological conversion methods have already been successfully implemented through funding of specific topics within the context of the Framework Programme “Biotechnology” (e.g. BioIndustry 2021,

Funding instruments

A proven funding instrument is the support of collaborative projects in research institutions and enterprises. The transdisciplinarity with the strong involvement of partners from science and economy along the innovation and value-added chain plays an important role. At the same time, this is a methodical challenge. Moreover, demand-driven collaborations with other groups of actors are scheduled. The spe-



BioEnergy 2021, Research into Microorganisms). The focal points of the present Research Framework Programme, however, are forestry and the timber industry as well as the handling of socio-economic issues within the framework of land management. Since, in particular, interdisciplinary approaches provide enormous innovation potentials through the connection of chemical and biotechnological processes, coordinated or joint funding of biotechnology and sustainability programmes are aspired.

Due to its orientation towards system-oriented research, the BMBF research funding in the topical field of biogenic raw materials complements application-oriented activities in the Research Programme “Renewable Resources” of the BMELV. The political objectives of the BMELV and the results gained are integrated in this Framework Programme.

cific support of innovative SME is another element of project funding. In addition, the transfer of research results into practice is of particular importance: innovative transfer paths shall continue to be tested or newly initialized. This includes the transfer of research results to vocational training. Furthermore, the collaboration with institutionally funded institutions, as e.g. the Max Planck Society and Federal departmental research institutes, shall take place on a strategic level.

Collaboration of several departments with the aim to unite innovation policy with the formation of framework conditions is stronger than ever. One example is the strategic collaboration with different Federal departments within the framework of the initiative “Steps towards sustainable resource management”.

First implementation steps

With the new funding priority “Sustainable Water Management“, sustainable system solutions for national and international challenges, arising due to regional scarcity of water and lacking or insufficient water supply and waste water disposal are developed in collaboration with economy, science and users. First funding announcements within the context of this funding priority will be published in 2010.

In a new funding priority “International partnerships for environmental and climate protection technologies“, model projects are intended to create and expand international partnerships in research, development and implementation of environmental technologies and to trigger off lead market developments in this field. This is expected to make substantial contributions to the reduction of greenhouse gas emissions, air and soil pollution and to the more ef-

In strategic partnerships, the way for new environmental and sustainability technologies shall be paved. The funding measure “Technologies for Sustainability and Climate Protection – Chemical Processes and Use of CO₂” contributes much to the achievement of the Federal Government’s goal to double energy productivity by 2020 in comparison to 1990 and to reduce CO₂ emissions by 40%. It is the first time that the funding measure deals with the topic of material use of CO₂, with particular focus on the synthesis of important basic and intermediate products.

The funding measure supports science and economy in their effort to jointly develop and test innovative technologies and methods both in the field of the avoidance and the material use of CO₂. In the field of “Resources and Energy Efficiency“, the funding initiative “SME innovative” continues to have no thematic restrictions and is aimed at all innovative SME from various industries. Regarding the measures mentioned above, approx. 500 million euros are provided for the investment in research and development projects over the next five years.

Moreover, close collaboration with European partners is aspired, at first within the framework of ERA-NET projects, in the long term also in Joint Programming initiatives.



Microalgae in the bubble column reactor

ficient use of energy, resources and land. At first, the focus is on economically strong countries like Brazil, Russia, India, China and South Africa.

Social Developments



The preservation of the natural bases of life cannot be separated from the issues of social, cultural, economic and legal development. Therefore, research must also go into the social preconditions and the consequences of sustainable development. Moreover, the development of instruments and methods is promoted, which are able to generate synthesis knowledge and to scientifically relate and link the fields of action mentioned so far.

Social aspects of sustainability and the contributions of socio-ecological research have already played a major role in the Framework Programme “Research for Sustainability“ (FONA) of 2004. Socio-ecological research analyses the dynamic interactions between individuals, society and the natural environment from which it deduces social action strategies for sustainable development. With this approach, the research direction acknowledges the fact that the preservation of the natural bases of life cannot be separated from issues of social, cultural and economic development.

In order to gain insights that can really be implemented, a transdisciplinary access to research is required, which comprises the collaboration of natural, economic, social and cultural sciences not only on a scientific level, but includes also the collaboration with actors from practice.

Humanities and social sciences should take a critical look at the sustainability research strategy as well as at issues of acceptance, technology transfer and impacts of technology, cultural resources, design and development.

Thus, transdisciplinary socio-ecological research lays the foundation for both the social discussion on future technologies and research results for the solution of the major global challenges. Chances and risks for the individual and for the society are realisti-



cally assessed and the achievable degree of consensus is evaluated.

Focal points of research funding

Creating options for working together with actors – governance for sustainable action

The Research for Sustainability framework programme had already offered funding – first and foremost in the focus of socio-ecological research – that is aimed at the totality of actors of sustainable development: apart from enterprises and research, these are mainly private households, municipalities and associations, political and economic institutions as well as NGOs. Together with these actors, the topical fields of supply and disposal, the fields of conflict of environment, agriculture, nutrition and

health, sustainable urban and regional development, the handling of systemic risks as well as new ways to sustainable consumer behavior are and will be surveyed in more than 50 joint research projects. Socio-ecological research contributes much to research for sustainable development by integrating different fields of knowledge, groups of actors and fields of application.

Since as a result of the evaluation of the socio-ecological funding programmes the continuation of the programme was recommended, the capacities established so far shall be secured and further developed in the next funding phase. To this end, the funding programme for junior scientist groups announced without thematic restrictions will be continued for another five years. Also, the strengthening of infrastructures in extra-university research institutes for transdisciplinary sustainability research, which do not receive basic financing, will be continued to secure the established capacities and to interlink the institutes more closely with university and institutionally funded parts of the science system.

The visibility of results is supported by specific publication and transfer measures. The growing research community shall be further supported to position itself on a European and international level. In the 7th EU Research Framework Programme, German extra-university institutes were able to succeed in competition with excellent transdisciplinary projects. In the ensuing phase, in particular the internationalization beyond EU borders shall be boosted.

The thematically oriented funding is mainly intended to better network transdisciplinary insights and the protagonists of socio-ecological research with the science and engineering-oriented fields of sustainability research. This is done through focusing on issues of climate change and climate protection. The results and methods of socio-ecological research shall be made available for the development of strategies to tackle climate change. The new focus regarding the “Social Dimensions of Climate Change and Climate Protection” will flank the activities in the field of action “Climate and Energy”.

In these projects, the social effects of climate change are to be examined as well as the effects of the measures taken to tackle it – as a specific concern of population groups or ambiances. Climate change and other factors with global effects influence the

Sustainable consumption



Since 2008, the BMBF has been funding ten collaborative research projects within the framework of socio-ecological research on the topic “From Knowledge to Action – New Paths to Sustainable Consumption”. By involving the relevant stakeholders (consumers, producing enterprises, trade,) practical knowledge required for the handling of every-day-life problems is integrated

and it is thus ensured that knowledge is produced which is adaptable and practical. In the project Intelliekon – Sustainable Energy Consumption By Households Based on Intelligent Meter, Communication and Rate Systems – feedback instruments are developed and tested together with energy providers and equipment manufacturers with the involvement of consumers.

These instruments make energy consumption in private households transparent and put people into the position to reduce their energy needs by taking appropriate action. The prerequisites for this are innovative measuring and metering technologies (smart metering) as well as corresponding communication channels between private households and energy providers.

In order to learn how this feedback must be designed so that it can be integrated best into the daily routine of private households (including technical parameters), new appliances and different feedback possibilities are tested in coverage areas of eight energy suppliers involved in the project. In collaboration with another practice partner, the best ideas for feedback design are converted into electronic devices in the development phase. The suitability for daily use of the feedback will be tested by more than thousand consumers for more than one year.

demographic development in various regions of the world and may cause conflicts which threaten the safety in the areas concerned. Changes in population structure and migration tendencies are therefore of great importance for sustainable development.

Economics for sustainability

The next funding phase of the funding priority “Economics for Sustainability” launched in 2005 will be concentrated on the further development of “Sustainability Economics”, which exists only in its basic form, and on shaping it without giving up openness to insights from other disciplines.

Essential aspects of sustainability economics are e.g. the relation between political and economic action with regard to sustainability, issues of funding

and the enforcement of normative basic ideas, such as sustainability in democratic and liberally structured societies as well as the dealing with long-term time- and decision horizons.

A topical focus will be the social dimension of sustainability from the economics point of view of. Here, inter- and intragenerational justice is concerned. Questions addressing the governance structures with view to sustainability as well as the demarcation between market and politics are paramount.

International and institutional integration

In collaboration with the national contact points “Environmental Research” and “Socio-Economic

Sciences and Humanities“ established by the Federal Ministry of Education and Research, the integration of German transdisciplinary sustainability research and humanities into the 7th EU Research Framework Programme will be strengthened. Transdisciplinary projects under German leadership have already been successful in the competition for EU-funds.

With the foundation of an “Institute for Advanced Sustainability Studies“ (IASS) in Potsdam, a place was created where scientists from all over the world meet for a certain time to research jointly and with the greatest possible freedom. The institute will be entrenched in the national and international landscape through strategic partnerships with selected universities and research institutions. The IASS will not only offer the scope for research, but also intensify the connection of research to society, economy and politics to pave the way for solutions for sustainable development.



Cross-Sectional Issues



Sustainable land management

Changes in land use

Changes in land use and global change are closely interrelated. The manner in which the Earth's surface and natural resources are used will be decisively influenced by the developments of the growing world population and migration problems, water scarcity and danger of floodings caused by global climate changes as well as by global agricultural and energy markets. Decisions on land use are predominantly made on regional or local level, in their totality however they affect global processes, for example, through increasing rural exodus or greenhouse gas emissions from agriculture – which will intensify non-sustainable development trends. If global change shall be sustainably addressed, land management as the basis of all socio-economic systems will be in the focus. Adequate land management is a future challenge, not only due to its fundamental importance for global and regional change, but also because of its immense complexity. Land use is in the area of tension between environmental and climate protection, energy supply and resource manage-

ment, food security and services of general interest. In this respect, land management is to be regarded as a highly complex field of action, which goes far beyond the classic sectors of agriculture and forestry and comprises aspects, like the use of water, soil or biodiversity, regional value creation, the relationship between urban and rural environments, quality of life, segregation into shrinking and prospering regions etc.

Thus, research on land management consistently pursues an integrative approach. With the aim to put the different dimensions of global and regional change – environment/climate, economy/technology, society/culture – in an overall context, research areas of scientific-technological disciplines (e.g. soil, water, eco-system, climate research, environmental, agricultural engineering), previously separated, are brought together with economic and social-scientific disciplines (e.g. environment, resource economics, settlement geography, social ecology, environmental ethics, governance research).

The effect of the involvement of economic and social sciences is that issues, previously treated under the scientific-technological focus, are now treated

under interdisciplinary aspects in the context of society as a whole. Therefore, the research area of “Land Management” is a cross-disciplinary integration of different but topic-related issues and thus a thematic focus.

The aim of land-use research is the creation of both the required knowledge and decision bases for sustainable land management and the provision of action strategies and instruments for a forward-looking adaptation of regional land use to global change. To this end, knowledge-based and implementation-based research is linked. This is a prerequisite for improved system understanding of the essential processes of global change and also helps identify interactions between ecological, economic and socio-cultural concerns – thus also conflicts of interest, which facilitates the search for future-oriented and sustainable system solutions. Research into land management generates implementation knowledge in terms of integrative action.

Since in this research area, scientific-technological views are specifically brought together with views from economics and the social sciences, an

outstanding and necessary basis for the closer linking of technological, non-technological and organizational innovations is formed. Feasibility is of central importance for the success of the funding activity; the final decision is made on the actors’ level (e.g. acceptance question, institutional framework conditions) and requires transdisciplinarity, such as the integration of decision makers and actors into the research process. The goal of this process is to achieve research results – e.g. as an impulse for service and sustainability innovations – which develop the desired social effectiveness. Global change and its regional effects are regarded as a challenge and a chance for Germany as an area for research and innovation in the sense of the High-Tech Strategy, the High-Tech Strategy on Climate Protection and the Masterplan Environmental Technologies.

The cross-sectional issue seizes the goals of the High-Tech Strategy to enhance the collaboration of science and economy/practice and thus to accelerate the economic exploitation of research results.

Moreover, the integrative approach enables the bringing together of different areas of innovation



After the stabilizing of sand dunes, seeds can accumulate and form a new cover of vegetation

of the High-Tech Strategy (e.g. environmental and water technologies, biotechnologies, services/knowledge economy). There are also close connections to the High-Tech Strategy "Climate Protection": New knowledge regarding the adaptation of land use to climate change is generated, and the contribution of various land management systems to mitigation is assessed. In view of the global importance of land use and sustainability issues, this research area can open up new export chances for German environmental technologies and environmental services. Moreover, the results and action strategies to be expected shall contribute to the implementation of national (e.g. Sustainability Strategy), European (e.g. Sustainable Development Strategy) and international agreements (e.g. Millennium Objectives, CBD).

Funding instruments

Research into land management in the context of global change must deal with highly complex issues and take into account the numerous, partly competing, societal demands (e.g. food security – bioenergy) as well as feedback mechanisms between society and ecosystems. Thus the focus is, in particular, on the interfaces of different user requirements.

In order to cope with this complexity, a region-related research concept is pursued, i.e. corresponding exemplary regions with view to elementary issues on land use (see below) are selected, based on which model-like and transferrable solutions are to be worked out. Regions are particularly suited as a common frame of reference for interdisciplinary research activities because they combine different viewpoints:

- **The region as a level of integration**
Here, the ecological, economic and socio-cultural effects of global change converge concretely (e.g. water scarcity, cultivation of cash crops, changed lifestyles and consumption patterns) and thus enable the integrative consideration of the interaction of the factors (e.g. integrated water resources or materials flow management).
- **The region as the central level of action**
Decisions on land use are taken at the local/regional level, so it is here, where the final decision on the viability of a solution is made.

- **The region as a level of participation**

On the one hand, with the involvement of regional actors practical knowledge is utilized for research in the sense of a transdisciplinary research approach; on the other hand, the acceptance of the developed proposals for solutions increases.

The funding activity is nationally and internationally oriented. Thus it contributes to the internationalization strategy of the BMBF. The global selection of exemplary regions is useful to cover the different aspects of global change (e.g. desertification).

Research on land use should be concentrated on regions that are particularly affected by global change, that are particularly relevant for certain key questions/basic problems or that are particularly suitable for the implementation of research results. This includes, for example, the highly dynamic growth regions of the world, where, due to environmental stress, the continuation of currently prevailing land-use practices is virtually impossible; regions particularly affected (e.g. by rural poverty or the impact of climate change) and with particular relevance in terms of natural features (e.g. drylands, mountains and coastal regions) can be selected as well.

This funding activity is characterized by inter- and transdisciplinarity, implementation orientation and a region-specific research concept. The main instruments are collaborative projects based on close collaboration with regional actors. The collaborative results shall be systematically integrated on a superior level (Meta-projects e.g. in the context of global economy, innovation potentials, and ethic questions). High importance is attached to the fact that already existing knowledge (i.e. results from diverse national and international funding programmes) is processed and integrated in a problem-related way.

The funding activity is oriented to the range of topics or problems mentioned below, which are to be treated based on model regions:

- Regional impact of global changes on land use, socio-economic conditions as drivers of change in land use
- Land management strategies including resources management for coping with the regional impacts of global change

- Interaction and feedbacks between land use systems and ecosystem services
- Urban-rural relations and transregional cooperation
- Interdependencies between land use options; solutions for competing uses and conflicting goals, exploitation of synergy potential
- Contribution of land use changes and land management strategies to greenhouse gas reduction goals
- Innovative technologies and services (socio-technical systems) for sustainable land management including technology assessment
- Innovative governance and participation models for the sustainable development of regions
- Importance of economic and legal framework conditions for innovative approaches.

Institutional funding

In view of the complexity of this topic, research on land management has various points of reference to the research programmes of the institutionally funded institutions of the Helmholtz Association, the Leibniz Association, the Fraunhofer-Gesellschaft and others. An example for this is the research area “Earth and Environment” of the Helmholtz Association. Furthermore, there are important research institutions of other departments, as for example the Deutsches BiomasseForschungsZentrum (DBFZ) newly established in Leipzig by the Federal Ministry of Food, Culture and Consumer Protection (BMELV).

A strategic coordination with the programmes of institutionally funded institutions occurs e.g. within the framework of discussions with experts. A key objective is to achieve synergies and complementarity between the various research approaches on a broad basis between the project-based funding of the Framework Programme and the programme-oriented funding of the Helmholtz Association.

First steps towards implementation

The goal of the starting funding measure “Land Management” is both the development of the required knowledge and decision bases for sustainable land management and the provision of the respective action strategy, technologies and system solutions. The interactions and interdependencies between land management, climate change and ecosystem services are in the focus. A second, mainly nationally oriented focus with its integrative approach is aimed at the development of sustainable land management systems and at perspectives for sustainable economic development. This includes also the integrated consideration of the rural-urban development. For these measures, altogether 100 million euros are earmarked for investments in research and development projects within the next four years.

Economy and sustainability

The concept of sustainability is directly connected with the economic activity of people: economic activity profits from the natural environment. At the same time, nature has a function as a sink for “excretions” of the economic system in the form of emissions and waste. Since both resources and the environment’s absorption capacity are limited, economic processes must be sustainable if long-term development goals shall not be sacrificed to short-term prosperity. In this context, a crucial question will be, which new governance structures are required to meet the aims of the national sustainability strategy. In the Framework Programme “Research for Sustain-



ability”, economy has already been integrated in the BMBF research activities on sustainability through networks between enterprises and research institutes. Moreover, specific approaches of economic sustainability research were funded. Within the context of this Research Framework Programme, specific economic competences, such as the assessment of ecosystem services or the development of strategies for innovation funding, shall be exploited more intensively for sustainability research.

The examples of the Stern report on the economy of climate change and those of the Shukdev report on the value of biodiversity have shown that eco-

economic analyses have an important function for the political assessment of sustainability strategies, for, on the one hand, they provide the methodical instruments for the quantification of revenue and expense of measures, on the other hand, they highlight economic chances arising from the early political guidance and funding of sustainability innovations.

Experience gained in recent years shows that, in a globalized world, isolated solutions for individual sustainability problems, which do not take into account the increasingly international intertwining of markets and political processes, will have little prospect for success. For example, successes of national sustainability strategies can be compensated and reversed by international economic mechanisms (key word “Rebound Effects”). On the other hand, globalization provides great opportunities, which can be seized by taking measures based on comprehensive analyses and considering the interactions of international markets and politics. Thus, not only does the connection of technical and political pioneer strategies in the field of environment and sustainability of the German economy secure competitive advantages, it also triggers new ways of sustainable development in developing and newly industrialized countries.

The other question, which keeps cropping up, in particular in the field of environmental and sustainability policy, is that of setting the boundaries between government and market and their collaboration. Conventional federal planning and control instruments reach their limits due to the long-term nature of the problems and the non-resolvable uncertainty regarding the effectiveness of approaches. In the conflict area between deregulation and new regulation efforts, it should be clarified, how collective or state power, able to assume responsibility for sustainable development, can be ensured. For this purpose, it must be clear how their capacities and instruments need to be designed in order to politically (with the electorate) and de facto (implementation) enforce sacrifices and limitations that have to be made and accepted by future generations. Here, the focus will be on the issues of governance, i.e. new forms of governance in politics and industry, as well as on the framework conditions for innovative and sustainable developments.

Problem child nature: How do people in Germany perceive their environment?



For a quarter of a century, researchers of the “Socio-Economic Panel SOEP”, supported by a polling agency, have interviewed more than 20,000 women and men of 12,000 households once a year about their economic and social situation and their hopes and expectations.

Thus, the SOEP is the biggest and longest running interdisciplinary longitudinal panel dataset

in Germany, which is used worldwide to examine trends in social development across a broad range of topics.

Results can be found for questions about sustainable development, e.g. about the attitude of mankind towards the conservation of nature – in this context, the name “Exxon Valdez” will always be tied to one of the most serious environmental disasters. The SOEP clearly reflects the reaction of the German population to this accident. In 1989, the proportion of respondents worrying about the environment amounted to almost 63 percent.

Such a high value has been reached neither before nor afterwards. Obviously, the oil spill has left massive traces in the environmental perception of the Germans. In the course of the 1990s, the environmental concern diminished continuously.

The explanation for the decreasing sensitivity is the fact that at this time, the growing unemployment seemed to be coming to the fore. During the past three years, the value has increased again. Since 1995, people have never rated their environment as bad as they did in 2007. Reasons for this development must be seen in the context of the worldwide debate on climate change, which becomes more heated.

Priorities of the research area

It is the goal of research to lay the foundations for knowledge and decision making and to find implementation strategies which guide national economies and the global economy as a whole towards a path of sustainable development. In the end, the international economic relations are increasingly intensifying and newly industrialized countries like Brazil, China and India show rapid economic growth. The research results to be expected here might contribute decisively to the firm establishment and implementation of national and international sustainability strategies.

Climate and energy

The climate protection goals of the Federal Government pose great challenges for the German econo-

my. The challenges for economic sciences are mainly the analysis of changes in global markets (energy and raw material markets, shifts in the structure of world trade, international technology transfer) to derive strategies for promoting the expansion of sustainable production and consumption patterns– in particular in the field of climate and energy.

Moreover, the difficult negotiations of the post-Kyoto agreement have shown that a fair system of burden-sharing in the adaptation to climate change as well as the distribution of rights to use and pollute resources are important issues of the international sustainability policy.

There is still great need for feasible action strategies. These, however, require the analysis and solution of the equity problems in the relationship

between industrialized and developing countries, but also in the relationship of today's and future generations. Since it is precisely in this respect that issues of population growth and migration are addressed (key word: "climate migration"), this also implies the analysis of demographic development processes and migration movements, in particular in connection with climate change.

The economic sciences introduce various methods for the modelling of socio-economic interactions, but also for the measuring and assessment of equity, which could serve the systematic treatment of equity effects in all sustainability dimensions.

Apart from the economic assessment of climate impacts and research on innovation potentials in the field of energy and climate, focal points of this research area will therefore also be the analysis of intra- and intergenerational equity problems of sustainability policy.

Natural resources

Permanently and reliably available natural resources are a prerequisite for sustainable economic activities. From the economic sciences' point of view, attention must be paid to the developments on the international commodity markets and to their economic, social and ecological impacts. In the case of renewables, this applies to an increasing extent even to the international agricultural market, and this both from a German and international perspective.

A strongly growing demand for raw materials may cause sharp price increases and a shortage on the respective markets within a short period of time, while the access to raw materials in general becomes more difficult. Such a development involves great challenges, as for example increasing pressure on ecosystems, increasing violence and conflicts through raw material production in politically instable regions and the insufficient securing of the participation of the respective producing countries in the profits from this sector.

Against this background, innovative strategies for sustainable resource management are needed. This can be done by supporting national commodity funds in resource-rich countries. Also important is the respect towards environmental and social standards when resources are produced and further processed. Here on the one hand, research is needed

on the analysis of feedbacks from the commodity funds to the international commodity and financial markets, and on the other hand, on the interdisciplinary development of indicators for the assessment of sustainability within the framework of "Ecolabelling" as well as the political implementation of standards in the area of tension of international environmental and trade policy.

For comparatively resource-poor industrial countries like Germany, demand-oriented measures are in the focus of strategy – against the background of the Federal Government's resources strategy. These measures shall contribute to the reduction of the resource demand (sustainable consumption), they are intended to develop innovative technologies for the economization of resources (sustainability innovations) and to support innovative strategies for the recycling of resources (key word "recycling management"). Economic sciences can make valuable contributions to this, e.g. to the better understanding of innovation processes, which are aimed at the increase of resource efficiency. There is need for research, in particular, regarding the development of methods of innovation and technology foresight, the integrative assessment of technological development paths (key word "path dependencies") and regarding the orientation of efficiency technologies towards strategically particularly important resources.

By identifying lead markets for German efficiency technologies, research contributes not only to the strengthening of the competitiveness of German economy, but also to the achievement of the sustainability goals of the Federal Government. In doing so, implementation and action knowledge for strategies of a sustainable resource management on national and global level shall be developed, i.e. considering global intertwining of resource flows and the international development of efficiency technologies. The variety of economic research approaches ranges from the consideration of technical or organizational innovations on company level (e.g. new business models), the integrated view of global value-added chains up to the issue of institutional anchoring of strategic measures as well as global governance.

Demographic change and social cohesion

Demographic change presents a major challenge for politics in Germany, for example, in the sustainable formation of the social security systems, the protection of public finances, the sustainable securing of

Research aircrafts



The research aircraft “Polar 5” is researching in the Earth’s polar regions. It is equipped with state-of-the-art technology and research infrastructures important in the extreme regions of the Earth. The new German high-altitude research aircraft for scientific investigation of the Earth’s atmosphere, “Halo” (High Altitude and Long Range Research Aircraft), replaces an observation system used for more than 25 years. “Halo” will contribute to the enhancement of the German and European atmospheric research in the international context.

supplemented by methods for the monetary assessment of unmarketable production structures in private households, relevant economic recommendations for the enhancement of social sustainability and lived solidarity can be derived.

Furthermore, the demographic development in its connection with socio-economic framework conditions, problems of longevity and migration should be surveyed.

an excellent level of knowledge and education in Germany or the coping with the process of regional shrinking. At the same time, these changes also provide opportunities for the strengthening of the civil society and for more solidarity between generations. Here, the connection of previously merely social-science based research on the prerequisites of an integrative society with economic sustainability research is very promising. Thus, an approach of socio-economic reporting allows the aggregate registration of the nearly marketable production performance of private households in time units by means of input-output charts. So far, these data are only hesitantly used for the solution of environmental and socio-political problems. From this basis and

Large-scale facilities and research infrastructures

Large-scale facilities and infrastructures such as stations, observatories and a network of measuring stations are indispensable for research. As a rule, they are operated by the Helmholtz Association or the Leibniz Association. All large-scale facilities consist of instruments beneficial to the community. Apart from the respective research work of the Associations mentioned, they can be used to carry out research for university institutions even on an international level. This provides universities with access to excellent research instruments, which they themselves cannot operate due to the complexity and the high construction and operating costs. Financing of construction and operation is based on the use and the application of the respective facility.

Polar stations

Germany maintains an Antarctic research station, which is operated all year round as an observatory for the observation of the Earth system in an environment that reacts extremely sensitively to global environmental changes. Moreover, it serves as a logistic platform for summer expeditions of German and international research teams. An infrasound measuring system in a worldwide monitoring network ensures the compliance with the Comprehensive Test Ban Treaty in the Southern part of our world. The third new building of the Antarctic station "Neumayer-III" was put into operation in the Antarctic summer 2008/2009. The German-French Research Station (AWIPEV) is situated on Spitzbergen. It provides research opportunities for the fields of biology, chemistry, meteorology as well as geophysics and atmospheric physics.

Research fleet

The application fields of German research vessels range from the Arctic to the Antarctic, from the Indian Ocean to the Barents Sea, from shallow coastal waters to the deep sea. Germany is internationally considered to be an important key player in modern marine research.

Earth observation satellites

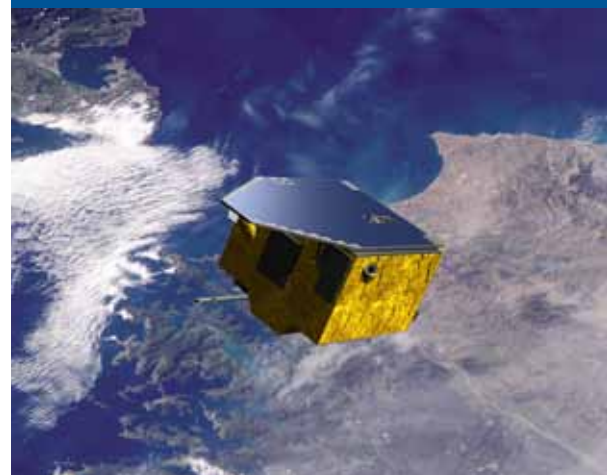
With satellites, versatile sensors for the observation of the Earth are used, which record the state of the Earth as our living environment, its changes and its dynamics on a global basis. Satellite pictures and measurement data are used by scientists, authori-

ties and political decision makers. Remote sensing data play an important role in the global observation of the system Earth and in the recording of natural disasters. Remote sensing methods help assess the risks of natural hazards and are used for the mission planning in case of catastrophes.

Social sciences

In the field of social sciences, in particular the Socio-Economic Panel, the German Data Forum and the research data centers play a leading role

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German research fleet

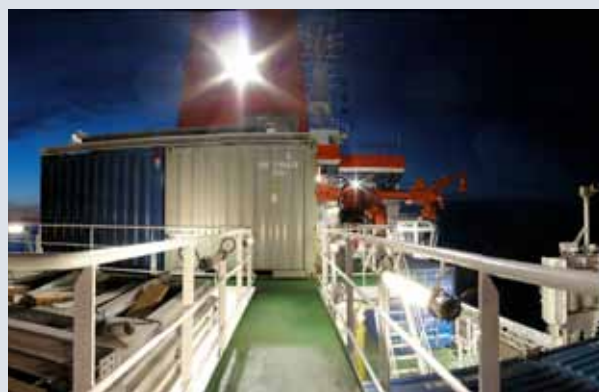


Marine research in Germany, with its world-leading contributions, depends on the use of research vessels. German research vessels are assigned to scientific institutions. These vessels are efficiently and economically operated in the interest of science and on the basis of the coordination agreed by the Federal and State Governments.

The Senat Commission for Oceanography of the German Research Foundation, the steering committee “Medium-Sized Research Vessels”, the Project Management Organisation Jülich, the control center “German Research Fleet” as well as the institutes of origin of the research vessels coordinate the use of the research vessels.

The “Polarstern” is the largest German research vessel. It is currently the most efficient research icebreaker in the world. In 1986, the “Meteor” was put into service and is mainly used in the Atlantic. With the “Sonne”, German marine research has a third large research vessel, which is predominantly used in the Pacific and the Indian Ocean. Since February 2006, the “Maria S. Merian” has been replacing the research vessel “Alexander von Humboldt”. The most modern multidisciplinary research vessel capable of entering the ice-margin

area shall be the most important working platform for expeditions to the Atlantic, the North Sea and the Baltic Sea within the next 25 to 30 years and is meant to examine the oceans’ influence on climate fluctuations.



The strategy document “The German Research Fleet – Requirements of the Next Decades” of the Senate Commission on Oceanography of the German Research Foundation and the German Marine Research Consortium sets out the future demand for research vessels.

Implementation and networking



Sustainable development is a cross-functional task. For the BMBF, this means forming a close network with other specialists and Framework Programmes, where sustainability aspects are discussed as well. Moreover, communication and networking of actors play a central role.

Connections to other BMBF-Programmes

Humanities and social sciences

The Humanities examine the cultural bases and contribute decisively to the shaping of our society's future. With their core competences and their holistic approach, they help overcome disciplinary, social, and cultural limits and shape our future in a holistic way. Research is carried out both at universities and at extra-university research institutions of the Max Planck Society and the Leibniz Association.

Focal points are, inter alia: International research collegia in the Humanities, thematic collaborative research, the development of the application field of research in and with museums to enhance the translation function of the Humanities. In order to strengthen the remote competencies, networks of area studies are funded. In future, the funding of the Humanities, social and economic sciences will be structured in a separate Framework Programme.

Production and materials sciences

With the framework concept "Research for the Production of Tomorrow", the BMBF supports the

research of new production technologies with the aim to develop exemplary solutions for a future-oriented production in Germany and to provide, in particular, small and medium-sized enterprises (SME) with research results for broad application. In the years to come, the BMBF provides more than 50 million euros for innovative research projects in which enterprises in collaboration with partners from science and research will develop trend-setting procedures and technologies for more energy and resources efficiency. The Framework Programme “WING –Materials Innovations for Industry and Society” is currently funding topics on materials, which increase energy efficiency or productivity and which contribute to higher resources efficiency for materials and energy in the end product as well as to higher environmental quality and quality of life.

Economically producible high-performance materials with long-term stability are often both bottleneck and chance at the same time. This is where the R&D-project funding of the BMBF starts in order to give enterprises, in cooperation with scientific institutes, impulses for new material technologies at an early stage and thus to sustainably increase the chances for innovative product developments. The WING Programme of the BMBF provides approx. 95 million euros each year for the funding of material technologies. Moreover, a new funding priority in the field of “Nanotechnology and Environment” is planned.

Biotechnology

Biotechnology, in particular green and white biotechnology, makes fundamental contributions to the solving of global problems. As one of the central key technologies of the 21st century, it contributes decisively to new environmentally friendly, energy- and resource-saving production methods and applications.

In view of the shifting of producing regions due to global climate change, the loss of biological diversity, the water shortage as well as the necessity to ensure feeding stuff and sufficient food for the growing population, the demands on the plant as a raw material are steadily rising. In order to enable the better adaptation of plants to drought, heat and other unfavourable environmental conditions, the more targeted use of the potentials offered by plant biotechnology is required. This goal is implemented by the new BMBF “Future Initiative for Bioenergy and

Healthy Nutrition”, which bundles all relevant research activities, such as plant research, agricultural and nutrition sciences as well as bioenergy research. Furthermore, the white or industrial biotechnologies make an important contribution to the development and the redirection towards sustainability in industrial production.



In detail, the following measures are linked with the sustainability topic:

- The white or industrial biotechnology belongs to the forward-looking fields of technology for sustainable, resource-saving and environmentally friendly economic cycles. The BMBF intends to combine and link the expertise of different disciplines in clusters to achieve the goal of developing and distributing biotechnology-based products and processes in numerous industries, which is described by the vision “BioIndustry 2021”. Apart from biosciences, also chemistry, physics, computer science and, in particular, engineering are concerned. The competition “BioIndustry 2021” is funded with altogether 60 million €. The clusters will be funded until 2011.
- The functional analysis of the genome of microorganisms is the prerequisite for innovations in the development of biotechnology-based products and processes in the agricultural economy, in the food sector, in the environmental sector or even in the pharmaceutical field. The BMBF

provides funding for projects which aim at genome research on microorganisms for human health, for the analysis and use of biodiversity and for environmental protection, agriculture and biotechnology. The current funding projects (GenoMik-Plus and GenoMik-Industry) started in 2006 and 2007, respectively, and were initially



planned to 2010. For this purpose, funding of approx. 45 million euros is provided. The foundation for innovations in the field of plant genome research was laid by the national funding priority Genome Analyses in the Biological System Plant (GABI) and the complementary international collaboration with in the framework of PLANT-Knowledge Based Bio Economy. Particular focus is on research projects for the determination of structure and function of genomes of *arabidopsis thaliana* (thale cress) and of barley (as model plants) and for the determination of structure and function of selected genome sections of important useful plants. The current funding projects (GABI-FUTURE and ERA-Net Plant Genomics) run from 2006 and 2007, respectively, until 2013. Funding of approx. 60 million euros is earmarked for this purpose.

- With the funding priority BioEnergy 2021, the BMBF aims to significantly increase the share of biomass in the energy supply and to reduce greenhouse gas emissions. Projects of universities and extra-university research institutions in

cooperation with partners from industry shall promote new conversion processes for biomass as well as the optimized cultivation of energy plants. The funding priority was launched in autumn 2007 and will run for 5 years. Funding of approx. 50 million euros is earmarked.

- For many years, developments of biotechnology and genetic engineering, in particular new fields of application in agriculture and the food industry have been discussed controversially in public. There are still questions regarding the effects on humans and on the environment. Current developments in the field of green genetic engineering highlight the need for a supporting biological security research. Against this background, the BMBF has been funding research projects for biological security research on genetically modified plants for several years. Current funding for biological security research runs from 2008 to 2010. For this purpose, about 10 million euros are earmarked.
- Agricultural and nutrition sciences play a central role in the solution of global problems as well as in the development of a future-oriented, sustainable economy based on bio-resources. Therefore, in 2007, the BMBF launched the funding activity "Competence Networks in Agricultural and Nutrition Research". Research networks from science and economy are supported, which aim at the entire agricultural value-added chain from original production of natural resources to the provision of high-quality raw materials and energy suppliers (foodstuffs, feeding stuff, biomass) to the consumer. The BMBF intends to support the development and expansion of competence networks in agricultural and nutrition research with up to 40 million euros within the next five years.
- The research union has recommended the establishment of a Bio-economy Council for the innovation field "Plant" (promoter: Dr. Arend Oetker, Stifterverband für die Deutsche Wissenschaft). Issues are, inter alia, the critical evaluation of individual processes for bioenergy production with regard to climate balance, efficiency and international competitiveness as well as the handling of the growing conflict of goals of the use of biomass (food vs bioenergy production). The research council is meant to bundle the relevant expertise from the fields of science, economy and

other social groups and to work out recommendations with regard to research funding as well as framework conditions for politics.

Education

Sustainability requires permanent deepening of knowledge on processes and their effects. This is only possible if education and training of people themselves is understood as a continuous and sustainable process. On the one hand, the implementation of new technologies, e.g. regarding the protection of climate and resources, requires the rapid diffusion of the demands on and the changes in professional qualifications and skills.



In order to better meet these constant challenges for business education, the BMBF intends to provide funding to develop suitable intercompany training centers (ÜBS) into competence centers (KomZet). These are able to process new technologies and innovative products in an application-oriented way and to integrate them directly into vocational training and further education. As a kind of link between development and implementation, the resultant competence centers shall have an exemplary effect and shall support the efficient transfer of knowledge to operational practice.

Moreover, a broad research and development programme for lifelong learning is to be launched. Its results will help provide the basis for devising and implementing innovative ideas in those areas where

measures cannot currently be implemented due to gaps in research and knowledge. Moreover, basic research in the field of lifelong learning shall be expanded to include the following issues:

- Effects of demographic change on the participation in lifelong learning,
- Effects of educational guidance on the participation in lifelong learning,
- Connection between learning behaviour and didactics,
- Intercultural and intergenerational learning,
- Continuing education in SME,
- Continuing education in the field of high-technology and in key industries.

38 million euros are earmarked for the programme running from 2007 to 2012.

Application procedure and funding instruments

The Framework Programme is basically implemented by public announcements of funding focal points. The best project proposals are identified in a competition-oriented procedure. Due to the thematically unrestricted programme framework, further topics or new priorities can develop if scientific, technical or social developments require it. They could then be worked on more intensely in the course of the programme.

Programm-Management

The BMBF coordinates the overall development of the Framework Programme, supported by an advisory panel of external experts. The announcements of funding are published in the Federal Gazette, on the BMBF homepage and on the internet platform www.fona.de. The project management agencies commissioned by the BMBF for the Framework Programme professionally advise the applicants on the programme goals and the possible forms of funding. The contact addresses can be found in the respective announcements of funding and on www.fona.de. The announcements on the funding priority provide detailed information on the application procedure.

As a rule, the applicants initially draw up a project outline within the framework defined in the announcements, which will then be evaluated with the involvement of an external body of experts. In the case of a positive evaluation, the applicant is requested to submit a detailed, possibly modified formal application.

This formal application is used as the basis for the decision on funding after a review of aspects related to the specific field and of administrative aspects. The assessment of the applications represents a key point of funding. Particularly the evaluation of interdisciplinary and transdisciplinary applications requires further development of the assessment procedures. The experience gained in various areas of funding in recent years will be utilized to ensure the most transparent and efficient assessment possible. The participation of international experts is envisaged for the selection of experts.

Innovative SME

Research funding of pre-competitive, high-risk innovation issues is only interesting for enterprises, in particular for SME, when implemented in a simple, quick and unbureaucratic way. The new Framework Programme aims for high participation of enterprises in the relevant public announcements with well-defined framework conditions. The integration of SME into cutting-edge research occurs by means of direct project funding, mainly by participation in collaborative projects. There are plans for the development of a funding module for small and medium-sized enterprises in different topics within the framework of the initiative "SME-innovative".

Within the context of the High-Tech Strategy for Climate Protection, representatives of business and science have produced recommendations for joint objectives and road maps for the most important technological sectors with relevance to climate protection. This kind of sector dialogue shall also be utilized for other emerging research topics. In future, innovation alliances shall contribute to a more active involvement of industry in research.

Junior academic groups

A special focus is on the funding of young researchers. In addition to the positions for post-graduate students in research projects, special instruments for the funding of junior researchers are provided, e.g. post graduate programmes on clearly defined issues and the establishment of working groups spearheaded by post-doctoral students

Intertwining of institutional funding and project funding

Extra-university sciences make fundamental contributions to research in the field of environment and sustainability. Therefore, institutional funding and project funding should be examined in more detail for potential synergies. The goals are optimization of the division of labour, specification of focal points and networking as well as a more pronounced competitive orientation. The collaboration is focused on central challenges and must be implemented in a coordinated way. It also comprises the collaboration in superior control bodies of the Framework Programme, including various working groups, for example for the planning and application of large-scale facilities, global-change research and geotechnologies. In this context, funding of interdisciplinary and transdisciplinary research plays a special role.

Quality assurance

The entity responsible for quality assurance is the respective department that issues the tenders. According to topic and orientation of the announcements, totally different approaches and methods can be selected, such as the ex-ante evaluation, audits or the ex-post evaluation. In addition, quality assurance is supported by high-level panels of experts, who accompany the Framework Programme right from the beginning.

Communication and networking

In order to properly process complex scientific issues, networking of researchers from natural sciences, Humanities and engineering is essential. Experience shows that interdisciplinary collaboration does not come automatically, but needs to be actively supported. Thus, this BMBF Framework Programme is meant to further boost the networking of scientific actors and to create the appropriate framework to this end.

For the understanding within the scientific community, the dialogue goes public. Research shall



open up to actors beyond sciences, include them actively in the research process and define their key questions from their point of view. A wide range of experience has already been made with the implementation of this kind of transdisciplinary research, which shall be the basis for this Framework Programme. Also, interdisciplinarity cannot be taken for granted, but requires active support – both from researchers and non-scientific actors.

Finally, it is aimed at stronger networking and communication between the projects to ensure the quick transfer of results into practice. The wider use of the results of sustainability research is achieved by the concentrated and comprehensive presentation

of information and research activities. This involves the following in-programme and cross-programme parallel measures – in cooperation with the project management agencies:

www.fona.de opens up new means of communication and interaction for sustainability actors. The internet platform offers information on contacts and contact data regarding project management agencies as well as all actors who are involved in research projects within the fona network or are active in the respective fields of research.

At the same time, fona depends on the active involvement of the actors, who have the opportunity here of presenting their own activities in research, development and education for stakeholders from society, industry and the field of training.

In addition, actors can also make use of the extensive range of services offered, and obtain information on current publications, events, press releases and requests for proposals or themselves point out interesting event dates and links. The annual BMBF Forum for Sustainability is an integral part of the Framework Programme. Here, actors find a platform for new ideas, personal exchange and networking.

Current results from funding priorities are presented, new collaborations are initiated and the exchange between politics, science, business and society on urgent questions of sustainability are driven forward.



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